Ordinal vs dichotomous analyses of modified Rankin Scale, 5-year outcome, and cost of stroke

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Cite as: Neurology® 2018;91:e1951-e1960. doi:10.1212/WNL.0000000000006554

Study objective
To compare how well ordinal vs dichotomized representations of the modified Rankin Scale (mRS) relate to long-term outcomes, and quantify trial ineligibility rates based on pre-morbid mRS.

Summary results
The ordinal representation of the mRS relates better to long-term outcomes than dichotomized representations, which may also promote less representative samples.

What is known and what this paper adds
The mRS is commonly used in stroke studies, but no consensus exists on whether ordinal or dichotomous analyses are preferable. This study provides evidence favoring ordinal analyses.

Participants and setting
This study included 1,421 3-month survivors of ischemic stroke (52.9% male; mean baseline age, 73.2 ± 12.7 years) in the Oxford Vascular Study, a population-based cohort in Oxfordshire. These participants experienced index strokes between April 2002 and March 2014.

Design, size, and duration
Participants were followed up to 5 years, with mRS scores recorded at 3-month, 6-month, 1-year, and 5-year assessments. Deaths and health- or social-care utilization were recorded from multiple sources. Age- and sex-adjusted regressions were used to relate 3-month mRS to 1- and 5-year mortality (logistic models) and 5-year care costs (generalized linear models). In these analyses, the 3-month mRS was coded as an ordinal variable, a 0–2/3–5 dichotomous variable, or a 0–1/2–5 dichotomous variable, and the representations were compared using c-statistics (mortality) and mean absolute errors (costs). The proportion of patients in whom pre-morbid mRS >1 or >2 would result in exclusion from trials using dichotomous analyses, was determined.

Main results and the role of chance
The ordinal representation outperformed both dichotomous representations in relating to 1-year and 5-year mortality ($p \leq 0.03$) and 5-year costs. 17.1% of 3-month survivors had pre-morbid mRS > 2 and 30.5% had mRS > 1; both proportions increased with female sex, socio-economic deprivation, and age ($p < 0.0001$).

Bias, confounding, and other reasons for caution
The analyses were not adjusted for all potential confounders like stroke subtype, comorbidities, and psychosocial factors.

Generalizability to other populations
The results may not apply to patients with conditions other than ischemic stroke.

Study funding/potential competing interests
This study was funded by the Wellcome Trust, the Wolfson Foundation, the UK National Institute for Health Research, and the Rhodes Trust. The authors report no competing interests. Go to Neurology.org/N for full disclosures.

### Table

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<th>mRS score representation</th>
<th>AUC (95% CI) for association with mortality</th>
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<tr>
<td></td>
<td>1 year post-stroke</td>
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<tr>
<td>0–1/2–5 dichotomous</td>
<td>0.790 (0.756–0.824)</td>
</tr>
<tr>
<td>0–2/3–5 dichotomous</td>
<td>0.823 (0.789–0.857)</td>
</tr>
<tr>
<td>Ordinal</td>
<td>0.843 (0.810–0.876)</td>
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Abbreviations: AUC = area under the curve (c-statistic); CI = confidence interval.
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Neurology 2018;91:e1951-e1960 Published Online before print October 19, 2018
DOI 10.1212/WNL.0000000000006554

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