

Letter to the Editor

Life expectancy after traumatic brain injury

To the Editor:

In their recent study, Harrison-Felix et al. [1] reported on long-term mortality after traumatic brain injury rehabilitation. They related mortality to the severity of disability at inpatient rehabilitation discharge, as measured by the Disability Rating Scale (DRS) of Rappaport et al. [2] As would be expected, their data show a clear trend: the more severe the disability the greater the mortality.

The authors estimated an average reduction of 7 years in life expectancy. We note that the data can also be used to estimate age-, sex- and DRS-specific estimates of life expectancy. An outline of the methodology follows:

1. After some additional standard Cox proportional hazards modeling of the data, we adopted a simple model with linear terms for age and DRS.
2. The estimated risk ratio for DRS was 1.126, indicating that the mortality risk increases by 12.6% for each increase of 1.0 on the DRS scale.
3. If we assume that a person with no disability (DRS = 0) is subject only to general population mortality rates, the estimated mortality rate for a subject with DRS = k is the general population rate times 1.126 raised to the k th power.
4. We then applied this rate to a subject of age $42 + 5 = 47$ years; 42 years is the mean age during the study period and the 5 years is an adjustment that recognizes the large variability around that age (for a discussion of this point, see Singer [3]).
5. To estimate mortality rates at other ages, as required in the construction of a life table, we used methods discussed by Anderson [4]; almost

equivalently, one could use those suggested by Strauss et al. [5] These methods give more accurate results than if one assumes that either the excess death rate or the relative risk is constant over all ages.

6. Finally, we used the resulting mortality rates at all ages to construct a life table, from which the life expectancy and other estimates of interest are immediately available.

For example, we calculated life expectancy using this model for a 30 year-old male with DRS = 5 (“moderate disability”) or DRS = 19 (“extremely severe”). When DRS = 5, there is an estimated 4-year reduction in life expectancy. However, when DRS = 19 the estimated life expectancy is only 22 years, or 50% of normal. Because of small sample sizes above a DRS score of 19 in the original study, extrapolation of these results to scores above 19 should be viewed with caution.

It is to be expected that the methodology will be refined and improved in future years as more data become available. Nevertheless, the above is based on standard methods and, to the extent that disability measures can be compared, gives results similar to those based on the California traumatic brain injury data [6,7].

David Strauss, PhD, FASA
Robert M. Shavelle, PhD, MBA
Michael J. DeVivo, DrPH
Cynthia Harrison-Felix, PhD
Gale G. Whiteneck, PhD

References

- [1] F.C. Harrison, G. Whiteneck, M. DeVivo, F.M. Hammond and A. Jha, Mortality following rehabilitation in the traumatic brain injury model systems of care, *NeuroRehabilitation* **19** (2004), 45–54.
- [2] M. Rappaport, K. Hall, H. Hopkins, T. Belleza and N. Cope, Disability rating scale for severe head trauma: Coma to community, *Archives of Physical Medicine and Rehabilitation* **63** (1982), 118–123.

*Address for correspondence: Michael J. DeVivo, Dr.P.H., 515 Spain Rehabilitation Center, 1717 Sixth Avenue South, Birmingham, AL 35233-7330, USA. Tel.: +1 205 934 3320; Fax: +1 205 934 2709; E-mail: devivo@uab.edu.

- [3] R.B. Singer, The application of life table methodology to risk appraisal, in: *Medical selection of life risks*, R.D.C. Brackenridge and J.W. Elder, eds, Fourth Edition, New York: Stockton Press, 1998, p. 52.
- [4] T.W. Anderson, *Life expectancy in court: A textbook for doctors and lawyers*, Vancouver BC: Teviot Press, 2002.
- [5] D. Strauss, R. Shavelle and M.J. DeVivo, Life tables for people with traumatic brain injury [letter], *Journal of Insurance Medicine* **31** (1999), 104–105.
- [6] R.M. Shavelle, D.J. Strauss, S.M. Day and K.A. Ojdana, Life expectancy, in: *Neurorehabilitation of Traumatic Brain Injury*, N.D. Zasler, D. Katz and R. Zafonte, eds, 2nd Edition, New York: Demos Medical Publishing, in press.
- [7] R. Shavelle and D. Strauss, Comparative mortality of adults with traumatic brain injury in California, 1988–97, *Journal of Insurance Medicine* **32** (2000), 163–166.