

## LETTER TO THE EDITOR

**Inconsistencies in methodologies of calculating expectation of life***Spinal Cord* (2013) 51, 938–939; doi:10.1038/sc.2013.95; published online 3 September 2013

Shavelle *et al.*<sup>1</sup> recently wrote to *Spinal Cord* with a re-calculation of the life expectancies in the paper of the current authors (Middleton *et al.*<sup>2</sup>).

The letter authors departed from theoretical correctness and consistency with both their own previous publications and well-recognized methodology in insurance and actuarial mathematics.

In Table 1 to their letter, they failed to adhere to the principle of concordance between mortality and exposure in applying empirical mortality rates to a life table developed more than 10 years after the mean period of exposure. Justifying this departure based on the secular trend in crude death rate in a small sample is inappropriate when over the same period the sample age standardized death rate for C5–8ABC decreased by about 20%, and for the whole Australian population by 34% from 1990 to 2010.<sup>3</sup>

In Table 2, they derive a life table using a methodology of constant mortality beyond age 80, which produces absurdities at older ages and

also distorts life expectancy results at younger ages. Moreover, this methodology is inconsistent with the approach the same authors have taken in different communications,<sup>4</sup> which have involved empirical standardized mortality ratios (SMRs) followed by constant SMRs after a certain age. This methodology can produce discontinuities, and also fails at older ages if the ‘constant age’ is too low (for example, age 60 years), giving crude mortality rates greater than 1.0. For the current example, a ‘constant age’ of 80 years gives results quite close to Middleton *et al.*,<sup>2</sup> and is theoretically more correct.

Table 1 demonstrates the error in the Shavelle letter, correctly determines SMRs on the principle of concordance using ALT1995–97, and reproduces expectations of life for C5–8ABC using the alternative Strauss methodology and that used in the Middleton paper. This methodology is also consistent with standard actuarial practice and provides equitable results compared to the purchase price of annuities and structured settlements.

**Table 1** Life expectancy for C5–8ABC

Age	<i>m(x)</i>	<i>e(x)</i> (Shavelle <i>et al.</i> <sup>1</sup> letter) <sup>b</sup>				<i>e(x)</i> Years <sup>c</sup>		Standardized mortality ratio (ALT95–97)			Alternative <i>e(x)</i> (years) <sup>d</sup>		Alternative <i>e(x)</i> (%ALT05–07) <sup>d</sup>	
		Years	% ALT95–97	% ALT05–07	ALT95–97	ALT05–07	Empirical <sup>a</sup>	Middleton <sup>e</sup>	Strauss <sup>f</sup>	Adopted <sup>g</sup>	Strauss <sup>f</sup>	Middleton <sup>e</sup>	Strauss <sup>f</sup>	Age
25	0.0069	36.5	69	66	52.9	55.8	6.4	5.4	6.4	41.3	40.8	74	73	25
30	0.0063	32.7	68	64	48.1	51.0		5.4	4.8	37.1	36.8	73	72	30
35	0.0063	28.7	66	62	43.4	46.2	4.8	5.4	4.8	33.0	32.5	71	70	35
40	0.0113	24.5	63	59	38.7	41.4		5.4	5.3	28.9	28.3	70	68	40
45	0.0113	20.8	61	57	34.0	36.7	5.3	5.4	5.3	25.0	24.4	68	66	45
50	0.0298	16.9	57	53	29.4	32.1		5.4	5.4	21.4	20.7	67	64	50
55	0.0298	14.2	57	51	25.0	27.6	5.4	4.9	5.4	18.1	17.4	66	63	55
60	0.0746	11.1	53	48	20.7	23.2		4.4	4.7	15.1	14.6	65	63	60
65	0.0746	10.0	59	52	16.8	19.1	4.7	3.9	4.7	12.4	12.2	65	64	65
70	0.0955	8.5	63	56	13.3	15.2		3.4	2.2	10.3	10.9	67	71	70
75	0.0955	7.2	71	62	10.2	11.7	2.2	2.5	2.2	8.5	8.2	72	70	75
80	0.1905	5.2	69	60	7.6	8.7		1.5	1.6	6.6	6.3	76	73	80
85	0.1905	5.2	93	84	5.6	6.2	1.6	1.5	1.6	4.5	4.3	73	69	85
90	0.1905	5.2	121	116	4.3	4.5		1.5	1.6	3.1	2.9	69	64	90

<sup>a</sup>The columns marked ‘Empirical’ are the observed values from Middleton *et al.*<sup>2</sup> In the case of standardized mortality ratios (SMRs), 10-year SMRs were calculated as the average across ages in the life decade (for example, 30–39).

<sup>b</sup>Expectations of life at each age using the methodology in the Shavelle letter, and empirical mortality rates. Note that this methodology fails at older ages, and this problem also has an impact on the calculations at younger ages.

<sup>c</sup>Expectations of life at each age according to the Australian Life Tables 1995–97 and 2005–07, respectively.

<sup>d</sup>Expectations of life (in years and percentage of Australian Life Tables 2005–07) at each age using the respective SMRs.

<sup>e</sup>SMRs adopted for C5–8ABC in the Middleton paper, according to the methodology described in the paper.

<sup>f</sup>SMRs implied for the C5–8ABC empirical observations in the Middleton paper, using our understanding of the methodology in Strauss *et al.*<sup>4</sup>

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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