THE MINNESOTA COGNITIVE ACUITY SCREEN(MCAS) - VALUABLE PREDICTOR OF MORTALITY

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Executive Summary *Cognitive Impairment testing has been a vital tool in evaluating Long Term Care Insurance (LTCI) applicants for many years. As insurers expand life insurance sales to higher issue ages, carriers have introduced cognitive screens to life insurance underwriting to identify applicants that have a potentially higher mortality profile.*

The Minnesota Cognitive Acuity Screen (MCAS) is a brief cognitive screen that has been validated to correctly identify mild to moderate cognitive impairment. This article presents the mortality experience from a large block of LTCI applicants for whom MCAS test results were obtained at the time of application. Mortality differentials by test score provide key insights into the potential this tool offers for life insurance risk assessment.

Background Information

The MCAS consists of nine brief subtests, one for each of the following categories: orientation, attention, delayed word recall (DWR), comprehension, repetition, naming, computation, judgment and verbal fluency. The scores from the nine subtests are combined to form an aggregate test score to determine if the test subject is considered to be "impaired" or "not impaired."

The MCAS is the only advanced cognitive screen that has been validated specifically for use in the insurance industry. The test can be administered both in person as well as telephonically. The MCAS is proven to be 98.1% effective in determining the presence or absence of mild to moderate cognitive impairment with 97.5% sensitivity and 98.5% specificity.

Methodology and Characteristics of Test Population

Univita (formerly Nation's CareLink) provided the data used for this mortality research study. The study data included information on 381,049 tests administered to applicants for LTCI from 1999 to August 2008 from more than 33 insurance carriers.

When a Social Security number was available, the applicant's Social Security number, last name, first name and birth date were compared to data in the Social Security Administration's November 2008 Death Master File (SSDMF) to identify applicants who had died during the study period. If a Social Security number was not available or did not match to a name and birth date, the applicant's last name, first name and birth date were compared to data in the SSDMF to identify additional applicants who had died during the study period. Subjects without a matching record in the SSMDF were assumed to live until the end of the study.

Actuarial exposure was calculated for each applicant within each calendar year in the study period. Exposure for each test subject began on the test date and ended on the earliest occurrence of: (1) a subsequent test (2) death or (3) August 31, 2008, which was the end of the study. Table 1 (next page, top left) summarizes counts of the exposure and deaths included in the study.

Mortality rates from the 2008 smoking unknown, select and ultimate, age last birthday Valuation Basic Table (VBT S&U ALB) were used to calculate the expected number of deaths. The 2008 VBT mortality rates by gender, test age and duration were applied to the exposure counts. The actual number of deaths was compared to the expected number of deaths to generate an actual-to-expected ratio.

Relative mortality ratios were calculated by dividing the actual-to-expected ratio for each category by the grand total actual-to-expected ratio. The graphs throughout this document display these relative mortality ratios bounded by approximate 95% confidence intervals based on the number of deaths and a normal distribution assumption. The bounds of the confidence intervals are:

$$\text{Mortality ratio} \pm (1.9604)(\text{mortality ratio})/\sqrt{\text{number of claims}}$$

MCAS Test Results

Results are aggregated based on the MCAS test score for each applicant. MCAS test scores range from -3.0 to 3.0. Applicants were classified as follows:

Characteristics of the Test Subjects (Table 1)

	Exposure Years (%)	Deaths (%)
Total	1,173,992 (100)	19,078 (100)
Gender		
Male	469,683 (40)	9,713 (51)
Female	704,309 (60)	9,365 (49)
Age at Test		
<60	198,580 (17)	725 (4)
60-64	179,079 (15)	1,322 (7)
65-69	249,792 (21)	2,731 (14)
70-74	247,684 (21)	3,866 (20)
75+	298,857 (25)	10,434 (55)
Duration		
1	335,849 (29)	2,406 (13)
2	253,998 (22)	3,090 (16)
3	186,608 (16)	3,182 (17)
4	145,324 (12)	3,075 (16)
5	105,864 (9)	2,710 (14)
6	70,807 (6)	2,016 (11)
7	44,894 (4)	1,516 (8)
8	25,593 (2)	906 (5)
9	5,055 (0)	177 (1)

Distribution of Applicants by MCAS Test Score (Table 2)

MCAS Test Classification	Number of Applicants	% of Total
Not Impaired	359,585	94.4%
Impaired	21,464	5.6%
Total	381,049	100.0%

Mortality Study Results by MCAS Test Classification (Table 3)

MCAS Test Classification	Relative Mortality Ratio	Number of Deaths	Life-Years Exposed
Not Impaired	91.8%	15,318	1,097,899
Impaired	157.2%	3,760	76,093
Grand Total	100.0%	19,078	1,173,992

Mortality Study Results by MCAS Test Classification and Gender (Table 4)

MCAS Test Classification	Relative Mortality Ratio		Number of Deaths		Life-Years Exposed	
	Female	Male	Female	Male	Female	Male
Not Impaired	91.9%	92.0%	7,732	7,586	669,952	427,947
Impaired	172.2%	145.0%	1,633	2,127	34,357	41,736
Grand Total	100.0%	100.0%	9,365	9,713	704,309	469,683

• "Impaired" if the aggregate MCAS test score is 0.0 or less.

• "Not Impaired" if the aggregate MCAS test score is greater than 0.0.

[see Table 2]

Mortality Results by MCAS Test Classification

[see Table 3 below]

The results showed that mortality is substantially higher among those applicants who were classified as "Impaired" by the MCAS. Mortality for the "Not Impaired" cohort is slightly lower than average. The relative mortality ratios are bounded by approximate 95% confidence intervals based on the number of deaths.

[see Figure 1, next page]

Although the general relationship of the mortality ratios is similar by gender, the mortality differential is larger for females than males.

[see Table 4 and Figure 2, next page]

Higher mortality ratios occur for impaired lives versus not impaired lives for all ages. The mortality ratio differences narrow as the applicant age increases. Note that due to the increasing number of deaths at the older ages, the confidence interval narrows at the older ages.

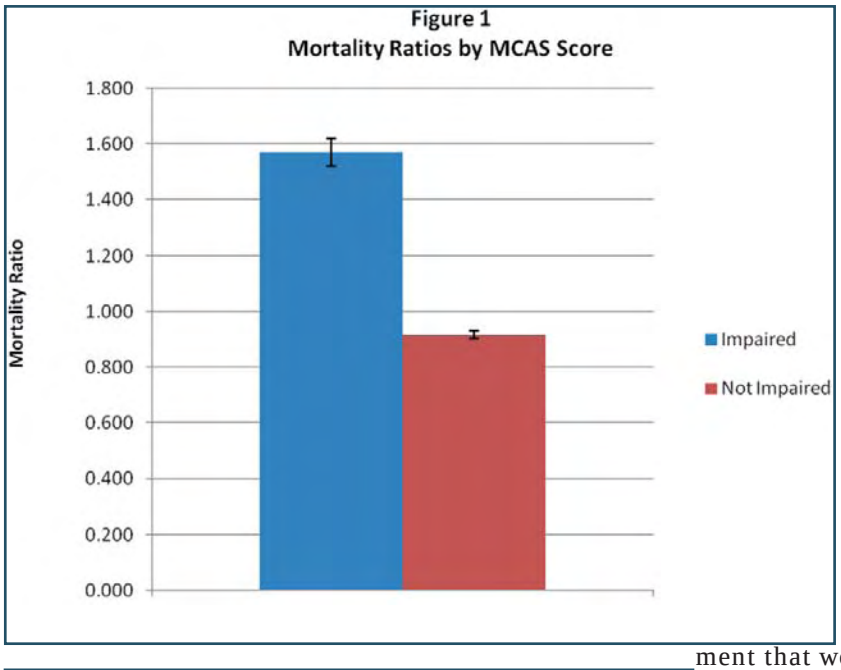
[see Table 5, next page and Figure 3, following page]

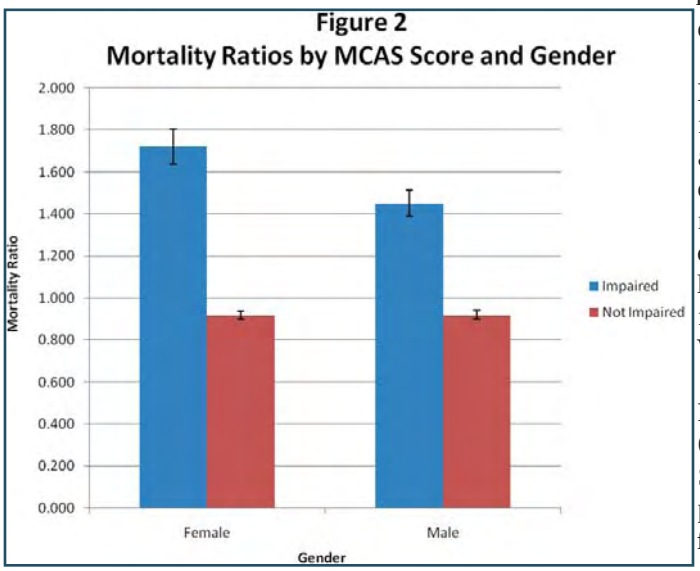
The mortality ratio differences narrow somewhat as time elapses from the test date. Nevertheless, significant differences in mortality are still present 7 to 8 years after test administration.

[see Table 6, next page, and Figure 4, following page]

In Table 7 (next page), the MCAS classifications of Impaired and Not Impaired are abandoned. The MCAS scores are classified in five groups rather than the original two classifications. The table indicates that finer gradations in test results than "Impaired" and "Not Impaired" could be used to classify mortality risks.

[see Figure 5, following page]





Protective Value

The MCAS screening can add positive protective value to life insurance underwriting if mortality savings that result from using the test exceed the cost of the test. Mortality savings can be calculated as the product of:

- Excess mortality = Present value of excess death benefits per $1,000 of face amount
- Insurance amount = Death benefit amount in $1,000's
- Prevalence = Impairment prevalence of the population applying for insurance
- Sensitivity = How good the test is at finding impaired risks
- Exclusivity = How often is this test the only means to uncover an impairment that would cause the underwriter to rate up or decline the application.

Excess mortality can be calculated using the relative mortality ratios for "Impaired" and "Not Impaired" applicants. Specifically, the actuarial present value of death benefits was compared for impaired and not impaired lives over an 8-year period. The calculations assumed a 6% discount rate, 6% annual lapse rate, and age, duration and gender specific mortality differentials relative to 100% of the 2008 VBT S&U ALB table.

For example, an impaired male applicant at age 67 has an actuarial present value of benefits of $137.76 per $1,000 of face amount. The actuarial present value of benefits is only $77.19 per $1,000 for an unimpaired applicant. The potential excess mortality savings is therefore approximately $60.57 per $1,000 of face amount issued.

At this age, we anticipate that 4.3% of applicants will be deemed impaired. Further, the MCAS test has a sensitivity of 97.5%. On the other hand, the "exclusivity" factor is unknown; this factor represents the degree to which the MCAS is the only source of available evidence to identify potential excess mortality.

Mortality Study Results by MCAS Test Classification and Age (Table 5)

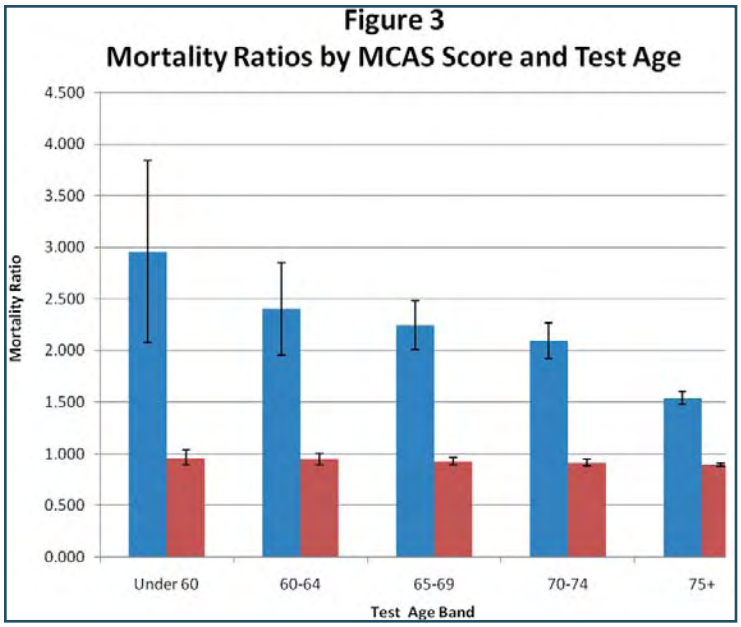
MCAS Test Classification	Relative Mortality Ratio by Age Band				
	0-59	60-64	65-69	70-74	75+
Not Impaired	96.0%	94.9%	92.7%	91.4%	89.2%
Impaired	295.8%	240.6%	224.6%	209.4%	154.3%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%

Mortality Study Results by MCAS Test Classification and Duration (Table 6)

MCAS Test Classification	Relative Mortality Ratio by Duration from Test								
	1	2	3	4	5	6	7	8	9
Not Impaired	90.6%	92.6%	92.0%	90.1%	90.9%	92.0%	93.9%	92.9%	95.8%
Impaired	183.2%	158.6%	155.4%	167.4%	160.8%	160.5%	138.5%	147.2%	128.5%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

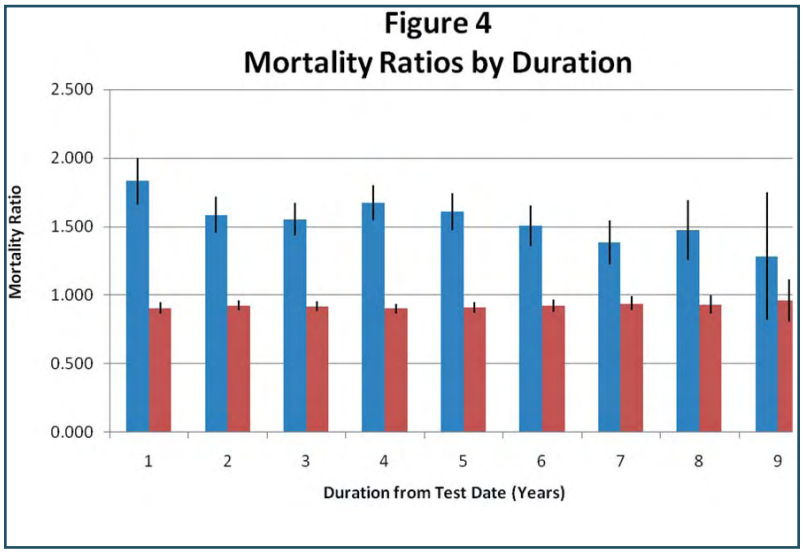
Mortality Study Results for Additional MCAS Classifications (Table 7)

MCAS Test Score Range	Relative Mortality Ratio	Number of Deaths	Life-Years Exposed
-3.00 to -1.51	190.7%	767	12,107
-1.50 to -0.51	169.2%	1,508	26,649
-0.50 to 0.49	121.4%	3,962	125,086
0.50 to 1.49	94.8%	7,992	472,276
1.50 to 3.00	79.6%	4,849	537,874
Grand Total	100.0%	19,078	1,173,992



The average expected mortality savings for a block of policies with average face amounts of $500,000 would then be $500 x $60.57 x 0.043 x 0.975 x Exclusivity = $1,279 x Exclusivity.

For the MCAS to provide positive protective value to the underwriting process, the mortality savings must exceed the cost of the test. While the cost of the MCAS test will vary, the required exclusivity of a $40 test at this age would be $40 / $1,279 = 3.1%. In other words, the MCAS test result must be the exclusive source identifying high risk impairment just once out of every 30 times the MCAS test reveals an impaired result. While each company's target markets and underwriting procedures will lead to different results, it seems very likely that a strong case can be made for using the MCAS even in a fully underwritten environment.



Since the cost to administer the MCAS does not vary by policy size or issue age, the exclusivity required for positive protective value is higher for policies issued at younger ages and smaller face amounts. Given that less evidence is typically collected for these policies, the exclusivity should naturally be higher. Conversely, although MCAS information for larger policies and older ages will be less exclusive due to the other information being collected, the potential mortality savings is much larger.

It is important to note that this study included mortality from all causes in the Social Security Master Death Tables. There is no emphasis on cognitive impairments. Therefore, exclusivity must be measured relative to all underwriting information.

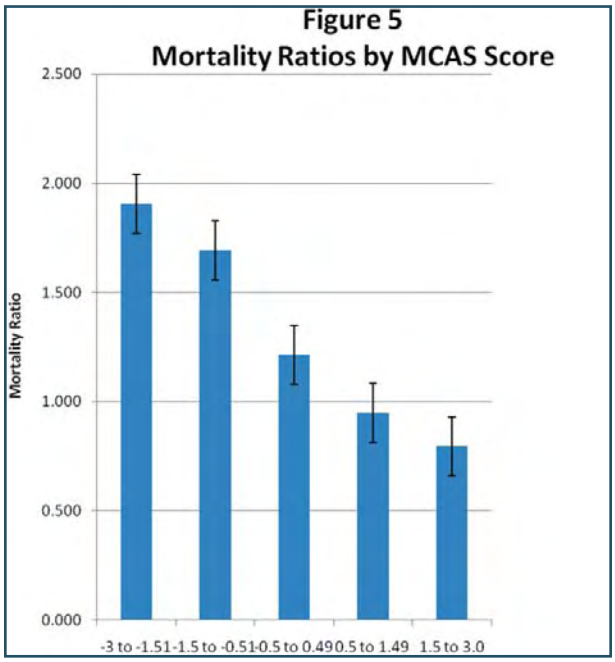


Table 8 (next page) provides required exclusivity percentages for various issue ages and face amounts.

Conclusions

This study establishes proof that MCAS test scores are useful in distinguishing the relative mortality risks of applicants for life insurance. Relative mortality is significantly worse than average for impaired lives and slightly better than average for non-impaired lives. Additionally, MCAS test results likely have a positive protective value for high face amounts and older ages for life insurance.

Required Exclusivity Percentages by Issue Age and Face Amount (Table 8)

Issue Age	$250,000	$500,000	$1,000,000
57	19.9%	9.9%	5.0%
62	9.7%	4.9%	2.4%
67	6.3%	3.1%	1.6%
72	2.8%	1.4%	0.7%
77	1.8%	0.9%	0.4%

References

Knopman et al. "Development and Standardization of a New Telephonic Cognitive Screening Test: The Minnesota Cognitive Acuity Screen (MCAS)" *Neuropsychiatry and Behavior Neurology* (October 2000); 13 (4) 286-296.

About the Author

Peggy Hauser, Senior Vice President, Actuarial Services, joined Univita Health (formerly Long Term Care Group - LTCG) in June 1998. Ms. Hauser provides actuarial support including product development, pricing, financial reporting, experience monitoring and analysis, and financial projections. Univita's five-member actuarial staff works closely with Univita Health's medical director, Dr. Stephen Holland, in analyzing Univita Health's administrative data to monitor and enhance underwriting and claim protocols. Prior to joining Univita Health, Ms. Hauser was a Principal at Milliman & Robertson, Inc., where her area of expertise was long-term care. She is a Fellow of the Society of Actuaries and a Member of the American Academy of Actuaries. Ms. Hauser is a frequent industry speaker and is active on several SOA committees. She can be reached by e-mail at phauser@univitahealth.com.