A124 Validation of the Total Body Score/Accumulated Degree Days (TBS/ADD) Equation at 100, 300, 500, and 1,000 ADD on 30 Human Subjects With a Known Postmortem Interval (PMI) From Three Human Decomposition Facilities

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After attending this presentation, attendees will understand that the equation associated with the TBS method using ADD is ineffective as a means to estimate the PMI and becomes progressively less accurate as the decomposition process proceeds.

This presentation will impact the forensic science community by demonstrating the need for new regional-specific equations for calculating ADD from TBS.

Beginning in March, 2015, a validation study of the TBS and regression equation for calculating ADD to estimate the PMI was conducted at three human decomposition research facilities, each having different climates (subtropical-sub-humid, temperate, and subtropical-humid).[1] The study was conducted at the Forensic Anthropology Center at Texas State (FACTS) at Texas State University in San Marcos, TX, the Anthropology Research Facility (ARF) at the University of Tennessee, Knoxville, TN, and the Southeast Texas Applied Forensic Science Facility (STAFS) at Sam Houston State University, Huntsville, TX. From March 2015 to June 2016, a total of 24 bodies were placed at each facility (total 72) during the spring, summer, fall, and winter seasons. Four subjects were placed on the ground surface at each facility each season; two in a shaded environment and two in the sun. Observations with TBS documentation and digital images were recorded daily. Data loggers captured daily temperatures and ADD was calculated.

The purpose of this study is to test inter-observer variability in the TBS and to examine the accuracy of the TBS/ADD equation developed by Megyesi and colleagues in the three environments.[1] A 30-subject subsample (ten subjects per facility) was selected for the validation study. The 30 subjects represent individuals placed in all four seasons and in both sun and shade. For the inter-observer test, photographs of ten subjects at different stages of decomposition were examined and researchers from each facility independently calculated the TBS. An Interclass Correlation (ICC) statistic test was used to assess the inter-observer error for the TBS as well as the score for each body portion. For the test of the TBS/ADD equation, photographs corresponding to 100, 300, 500, and 1,000 ADD were selected from each of the 30 subjects. Using the TBS/ADD equation ($ADD = 10^{(0.002*TBS*TBS+1.81)} \pm 388.16$), the mean and range of ADD for each subject was compared to actual ADD.

The inter-observer test exhibited no statistically significant differences between researchers. The average measures for absolute ICC for the head presented near perfect agreement between observers (.959). The trunk

displayed even greater agreement (.975) and the limbs demonstrated the least agreement (.940), but still was not statistically different ($p<0.001$). Based on this study and a recent study conducted by Dabbs and colleagues, it is clear that assessment of TBS from digital images is reliable and consistent between observers.[2]

The results of the calculated ADD exhibited significant variation between actual and estimated ADD. The difference between the actual and estimated mean ADD increases as ADD increases. For example, at 100 ADD (TBS 7), the TBS/ADD equation mean for all 30 subjects is 80.9 with a range of 0 to 475 ADD. At 300 ADD (TBS 26), the estimated mean is 1,452 with a range of 1,064 to 1,840 ADD. In addition, there was a significant overlap of ADD ranges in more advanced stages of decomposition when TBS increased. Numerous individuals remained at the same advanced TBS for more than 1,000 ADD at each of the three facilities.

This validation study demonstrates that TBS can be reliably calculated for human remains, but the equation for estimating ADD provided by Megyesi and colleagues is insufficient, especially as PMI increases, regardless of the decomposition environment.[1] Other means of estimating PMI have been suggested and are also being.[3] The current study is two years and validation of revised equations pertinent to each unique climate or a new PMI method will be performed in the second year.

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Reference(s):

1. Megyesi M.S., Nawrocki S.P., Haskell N.H. 2005. Using ADD to estimate the postmortem interval from decomposed human remains. *Journal of Forensic Sciences.* 50(3):1-9.
2. Dabbs G.R., Connor M., Bytheway J.A. 2016. Interobserver reliability of the total body score system for quantifying human decomposition. *Journal of Forensic Sciences.* 61(2):445-451.
3. Bates L.N., Wescott D.J. Not all degree days are equal in the rate of decomposition: the effect of season of death on the relationship between gross postmortem decomposition and accumulated degree days. *Proceedings of the American Academy of Forensic Sciences*, 68th Annual Scientific Meeting, Las Vegas, NV. 2016.

Total Body Score, Validation Study, ADD Regression Equation