The Effect of Hydration Status on King-Devick Concussion Assessment and Symptoms Scores in Healthy Collegiate Athletes

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ABSTRACT

PURPOSE: To investigate the effects of hydration on concussion assessments including the King-Devick test and the Sport Concussion Assessment Tool 3 (SCAT3) symptom score.
METHODS: Twenty-eight Division III collegiate athletes (18-25 years of age) participated in this study. Each participant had two baseline King-Devick tests, a symptom score, and a urine specific gravity (USG) assessment. Participants then reported in a hydrated state (USG ≤ 1.021) and a hypohydrated state (USG ≥ 1.027) with at least 72 hours between each testing session. At the beginning of each testing session, participants completed a USG assessment to assure appropriate hydration parameters were reached. A King-Devick test and a symptom score were then completed.
RESULTS: A paired-sample t-test indicated that King-Devick time was greater in a hypohydrated status as compared to a hydrated status, $t(27) = 2.44$, $p = .022$. There was also significant differences in symptom score and symptom severity in a hypohydrated state versus a hydrated state, $t(27) = 2.97$, $p = .006$ and $t(27) = 2.41$, $p = .023$).
CONCLUSION: Hypohydration negatively affects symptom scores and King-Devick test time. When using the King-Devick test to assess concussion status, consideration of hydration status is needed.

INTRODUCTION

- Current popular concussion assessment tools include the Sport Concussion Assessment Tool (SCAT), the Balance Error Scoring System (BESS), the Immediate Post-Concussion Assessment and Cognitive test (ImPACT), and the Vestibular Ocular-Motor Screening (VOMS).
- Vision related assessments of vestibular ocular motor control have become increasingly popular for concussion diagnosis in recent years because the visual system has countless connections to pathways that travel from the eyes to the frontal, parietal, and temporal lobes (Galetta et al., 2015).
- "The King-Devick is a objective test based on the measurement of the speed of rapid number naming, and captures the impairments of eye movements, attention, language, and other correlates of suboptimal brain function" (Galetta et al., 2011).
- No current research on the influence of hydration on the King-Devick test assessment.

PURPOSE

The purpose of this study was to investigate the effects of hydration on concussion assessments including the King-Devick test and the Sport Concussion Assessment Tool 3 (SCAT3) symptom score.

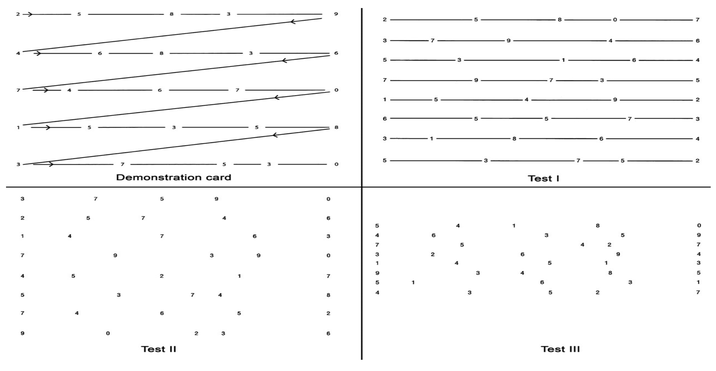


Figure 1. Demonstration and Test Cards for King Devick Test

METHODS

Participants

- Twenty-eight collegiate athletes (18-25 years of age) from a Division III Midwest university.
- Inclusion criteria was no previous diagnosis of concussion, visual impairments diagnosed by an ophthalmologist, diagnosis and/or treatment for attention deficit/hyperactivity disorder, or Type 1 Diabetes.

Table 1. Demographic Characteristics of Participants

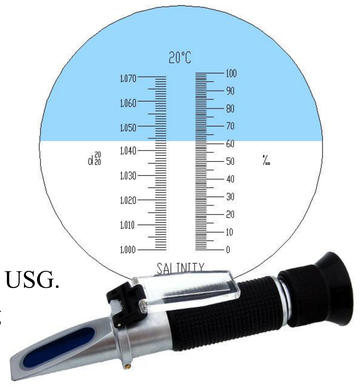
Sport	Number	% of cohort
American Football	3	11%
Basketball, Women's	6	21%
Basketball, Men's	2	7%
Gymnastics, Women's	1	3.6%
Track & Field	8	29%
Soccer, Women's	1	3.6%
Softball	1	3.6%
Swim & Dive	2	7%
Wrestling	4	14%

Procedures

- Participants completed the pre-test questionnaire to determine eligibility and were instructed on how to obtain a midstream urine sample from which the urine specific gravity (USG) was recorded using a refractometer.
- Two error free baseline King-Devick tests were obtained per manufacturer recommendations, followed by a SCAT3 symptom score.
- Participants were randomly assigned to hydration groups. Hydrated and hypohydrated parameters were assessed per person during testing process.
- After hydration threshold was achieved for each session participants then were given a SCAT3 symptom score assessment and completed a King-Devick test assessment utilizing an iPad.

Hydration parameters:

- Hypohydrated parameters included USG greater than or equal to 1.027.
- Hydrated parameters included USG less than or equal to 1.021.
- The ATAGO Urine Specific Gravity Refractometer URC-NE was used to assess USG.
- These parameters were based on morning USG of initial urine sample from a study done by Armstrong et al. (2010).



Study Design

- A paired sample t-test ($\alpha = .05$) was used to test hypothesis 1, which stated that participants will have slower King-Devick test times in a hypohydrated state than when in a hydrated state.
- A paired sample t-test ($\alpha = .05$) was also used to test hypothesis 2, which stated that participants would report a greater number of symptoms and increased symptom severity when in a hypohydrated state compared to a hydrated state.
- Pearson Product Moment Correlation analysis was also run to determine if a relationship was present between the hours of sleep each participant achieved the night before each session and the time it took for them to complete the King-Devick test.

RESULTS

Table 2. Results of Paired Samples t-tests

Outcome Variable	T	Df	*p*
KD test time			
H1: KD test time of hydrated < hypohydrated	-2.44	27	.022
Number of symptoms			
H2: Number of symptoms for hydrated < hypohydrated	-2.97	27	.006
Symptom Severity			
H2: Symptom severity for hydrated < hypohydrated	-2.41	27	.023

Note. All analyses had Type I error rate (alpha) set at .05. $N = 28$. King-Devick abbreviated as KD.

- Hypothesis 1 supported: The mean King-Devick test time for the hydrated states (M=43.60, SD=6.01, N=28) was significantly faster than the mean King-Devick test time for hypohydrated states (M=44.83, SD=7.23, N=28).
  - Hydrated individuals completed the KD test faster then hypohydrated individuals.
- Hypothesis 2 supported: The mean number of symptoms reported in the hydrated states (M=0.14, SD=0.45, N=28) was significantly lower than the mean number of symptoms reported in the hypohydrated states (M=1.36, SD=2.25, N=28).
- A significant difference was found in the severity of symptoms scores reported between hypohydrated (M=2.14, SD=4.35, N=28) and hydrated states (M=0.18, SD=0.55, N=28).
  - Hydrated individuals reported fewer symptoms on their SCAT3 assessment than did hypohydrated individuals.
  - Athletes rated their symptoms more severely when they were hypohydrated versus hydrated.
- A Pearson Correlation analysis showed no significant relationship between hours of sleep and King-Devick test time (r=.077, p=.484).

CONCLUSIONS

- Hypohydration negatively affects symptom scores and King-Devick test time. When using the King-Devick test to assess concussion status, consideration of hydration status is needed.
- Implications of this study show that there is a potential need for awareness or assessment of hydration status when taking baseline concussion assessments.
- Future research is suggested to investigate the effects of hydration status on other concussion assessments to ensure accurate measures of baseline tests.
- Other future directions for research should include individuals who have been previously diagnosed with a concussion.

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