

# ORIGINAL RESEARCH

## DEVELOPMENT OF A SCREENING PROTOCOL TO IDENTIFY INDIVIDUALS WITH DYSFUNCTIONAL BREATHING

Kyle Kiesel, PT, PhD<sup>1</sup>  
Tonya Rhodes<sup>1</sup>  
Jacob Mueller, ATC<sup>1</sup>  
Alyssa Waninger<sup>1</sup>  
Robert Butler, PT, PhD<sup>2</sup>

### ABSTRACT

**Introduction:** Dysfunctional breathing (DB) has been linked to health conditions including low back pain and neck pain and adversely affects the musculoskeletal system. Individuals with DB often have decreased pain thresholds and impaired motor control, balance, and movement. No single test or screen identifies DB, which is multi-dimensional, and includes biochemical, biomechanical, and psychophysiological components. Several tools assess and test for DB, but no screen exists to determine whether additional testing and assessment are indicated.

**Purpose/Background:** The purpose of this study was to develop a breathing screening procedure that could be utilized by fitness and healthcare providers to screen for the presence of disordered breathing. A diagnostic test study approach was utilized to establish the diagnostic accuracy of the newly developed screen for DB.

**Methods:** A convenience sample of 51 subjects (27 females, 27.0 years, BMI 23.3) were included. To test for DB related to the biochemical dimension, end-tidal CO<sub>2</sub> (ETCO<sub>2</sub>) was measured with a capnography unit. To test for DB related to biomechanical dimension, the Hi-Lo test was utilized. To test for DB related to the psychophysiological dimension, the Self Evaluation of Breathing Symptoms Questionnaire (SEBQ) and Nijmegen questionnaires were utilized. Potential screening items that have been shown to be related to DB in previous research and that could be performed by non-health care personnel were utilized to create the index test including activity level, breath hold time (BHT), respiration rate, and the Functional Movement Screen (FMS™).

**Results:** There were no strong correlations between the three measures of DB. Five subjects had normal breathing, 14 failed at least one measure, 20 failed at least two, and 12 failed all three. To develop screening items for each dimension, data were examined for association with failure. BHT and a four-item mini-questionnaire were identified as the most closely associated variables with failure of all three dimensions. A BHT of < 25 seconds and four questions were combined and yielded a sensitivity of 0.89 (0.85-0.93) and a specificity of 0.60 (0.18-0.92) for clinical identification of DB.

**Conclusion:** Easily obtained clinical measures of BHT and four questions can be utilized to screen for the presence of DB. If the screen is passed, there is an 89% chance that DB is not present. If the screen is failed, further assessment is recommended.

**Level of Evidence:** 2b

**Key Words:** Breath holding, disordered breathing, hypocapnia, sensitivity

### CORRESPONDING AUTHOR

Kyle Kiesel  
Professor of Physical Therapy  
University of Evansville  
1800 Lincoln Avenue  
Evansville, Indiana 47722  
USA  
E-mail: Kk70@evansville.edu

<sup>1</sup> University of Evansville, Evansville, IN, USA

<sup>2</sup> Director of Performance, St. Louis Cardinals, St. Louis, MO, USA

The Institutional Review Board at the University of Evansville approved this study

Funding provided through the Ridgway Student Research Award from the University of Evansville