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Evaluation of the Forced Inspiratory Suction and Swallow Tool to Stop Hiccups

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Introduction

Home remedies to relieve transient hiccups, such as breath holding, recycled breathing in a paper bag, and drinking water from the far side of a glass, are plagued by unclear instructions, inconsistent performance, and poor effectiveness. There is a need for a simple and effective method to stop hiccups. The forced inspiratory suction and swallow tool (FISST) has a low-cost design and straightforward mode of action that stimulates the phrenic and vagus nerves by inducing diaphragmatic contraction and epiglottis closure, respectively. The study hypothesis was that patients with hiccups would associate FISST with more effective termination of transient hiccups compared with home remedies.

Methods

FISST is a rigid drinking tube with an inlet valve that requires suction effort to draw water from a cup into the mouth. Generation of high negative intrathoracic pressure requires contraction of the diaphragm and is followed immediately by closure of the epiglottis. FISST has been patented and branded as “HiccAway” (Figure). This study was exempt from full review by the institutional review board.

Figure. Forced Inspiratory Suction and Swallow Tool

The tool has a mouthpiece on the top, a body in the middle, and an adjustable cap with a pressure valve on the lower end. The valve and the body’s dimensions are designed to generate approximately −100 cm H₂O in adults and −50 cm H₂O in children. Directions: Get a cup half-filled with water and submerge the lower end under water. Forcefully suction through the mouthpiece and subsequently swallow the water; expect some resistance when you suction the water. The hiccups are usually expected to stop instantly in 1 to 2 attempts.

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board at the University of Texas at San Antonio because it is not regulated research as defined by the US Department of Health and Human Services regulations per 45 CFR §46 and the US Food and Drug Administration regulations per 21 CFR §56. In this cross-sectional study, FISST was offered worldwide to volunteers, through an online kickstarter campaign in 2020, and followed up for 4 months prospectively. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline was followed. Globally, 674 participants with hiccups volunteered to receive the device, and 290 participants (43%) provided written consent to participate in the study. An online questionnaire eliciting subjective experience with FISST based on a 1 to 5 Likert scale (where 1 is strongly in favor of home remedies, 2 is in favor of home remedies, 3 is represents parity, 4 is in favor of FISST, and 5 is strongly in favor of FISST) was provided. The primary outcome was the subjective effectiveness of FISST compared with home remedies in the sample of participants who responded. The secondary outcome was overall subject satisfaction, described as feasibility. Mean (SD) comparison and satisfaction scores were computed. Both tests used a 95% CI with \( P < .05 \) denoting 2-tailed statistical significance between comparator groups. The data were analyzed using IBM SPSS Statistics for Windows, version 25 (IBM Corp).

**Results**

A total of 249 responses were validated, with a mean (SD) age of 30.9 (19.3) years (range, 1-90 years), primarily adult (175 of 249 participants [70.3%]), female (126 of 249 participants [50.6%]), and White (197 of 249 participants [79.1%]). Most participants (69.5%) reported hiccups at least once a month, and most (65.9%) had hiccups of less than a 2-hour duration. FISST stopped hiccups in nearly 92% cases and was rated favorably compared with home remedies across all demographic characteristics, hiccup frequencies, and hiccup durations (Table). The mean (SD) subjective effectiveness score of FISST was 4.58 (0.90) in the sample of participants who responded, with 183 of 203 participants (90.1%) rating it favorably (4 or 5) compared with home remedies. The mean (SD)

| Characteristic | Participants, No. (%) (N = 249) | Subjective effectiveness (from 5)\(^a\) | User satisfaction (from 5)\(^b\) |
|---------------|---------------------------------|------------------------------------------|---------------------------------|
|               | Mean (SD) \( P \) value\(^a\)   | Mean (SD) \( P \) value\(^b\)           |                                 |
| **Age group, y** |                                  |                                          |                                 |
| Children (≤15 y) | 74 (29.7)                        | 4.57 (0.90)                              | 4.66 (0.87)                     | .62                             |
| Adult (≥16 y)   | 175 (70.3)                       | 4.59 (0.91)                              | 4.55 (1.01)                     | .45                             |
| **Sex**         |                                  |                                          |                                 |
| Female          | 126 (50.2)                       | 4.66 (0.77)                              | 4.69 (0.87)                     | .27                             |
| Male            | 123 (48.6)                       | 4.49 (1.01)                              | 4.46 (1.12)                     | .11                             |
| **Race/ethnicity** |                                |                                          |                                 |
| Asian/Pacific Islander | 27 (10.8)                   | 4.36 (1.01)                              | 4.48 (1.12)                     | .51                             |
| Black           | 8 (3.2)                          | 4.83 (0.41)                              | 4.13 (1.46)                     | .67                             |
| Hispanic        | 17 (6.8)                         | 4.67 (0.82)                              | 4.76 (0.44)                     |                                 |
| White           | 197 (79.1)                       | 4.60 (0.88)                              | 4.59 (0.96)                     |                                 |
| **Hiccup frequency** |                              |                                          |                                 |
| Every day       | 11 (4.4)                         | 4.22 (1.57)                              | 4.27 (1.62)                     | .10                             |
| Very often (every week) | 53 (21.3)             | 4.50 (0.76)                              | 4.55 (0.87)                     | .45                             |
| Often (every month) | 109 (43.8)               | 4.59 (0.93)                              | 4.54 (1.03)                     |                                 |
| Not very often (a few times a year) or rarely | 76 (30.5) | 4.68 (0.83)                              | 4.68 (0.82)                     |                                 |
| **Longest hiccup duration, h** |                              |                                          |                                 |
| <48             | 238 (94.6)                       | 4.61 (0.84)                              | 4.60 (0.93)                     | .21                             |
| ≥48             | 11 (5.4)                         | 4.00 (1.61)                              | 4.00 (1.61)                     | .18                             |
| All cases       | 249 (100)                        | 4.58 (0.90)                              | 4.57 (1.61)                     |                                 |

\(^a\) Some variables had a missing value in effectiveness (46 participants did not answer the effectiveness question).

\(^b\) Determined by use of the Mann-Whitney test or the Kruskal-Wallis test.
satisfaction was 4.57 (1.61), with 226 of 249 participants (90.8%) rating FISST more feasible than home remedies (4 or 5). No adverse effects were reported.

Discussion

This study supports the use of FISST as an option to stop transient hiccups, with more than 90% of participants reporting subjectively superior results compared with home remedies. Many home remedies consist of physical maneuvers designed to stimulate contraction of the diaphragm and/or closure of the epiglottis. These maneuvers lack clear, standardized instructions and can be cumbersome to perform, and there are few, if any, scientific studies of their effectiveness. Pharmacological and other therapies have had varying levels of success, and adverse effects are a concern.² ⁴ A systematic review concluded that there was a lack of high-quality data on which to make any strong recommendations.⁵

The limitations of the study include the absence of a control group and the subjective nature of the scoring system. The strengths of the study include the prospective nature of the study, the relatively large sample size, and the broad applicability of the results.

FISST is an easy-to-use tool to relieve transient hiccups. The sample of participants who responded to the online questionnaire associated the device with superior results compared with home remedies. Future studies will need to assess the efficacy of FISST in randomized clinical trials.
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REFERENCES
1. Seifi A, inventor. Hiccup relieving apparatus. US patent application publ. US 2020/0188619 A1. June 18, 2020. US20200188619A1.pdf. Accessed January 14, 2021. https://patentimages.storage.googleapis.com/c1/fa/54/c983a34c045f36/US20200188619A1.pdf

2. Ramírez FC, Graham DY. Treatment of intractable hiccup with baclofen: results of a double-blind randomized, controlled, cross-over study. Am J Gastroenterol. 1992;87(12):1789-1791.

3. Wang T, Wang D. Metoclopramide for patients with intractable hiccups: a multicentre, randomised, controlled pilot study. Intern Med J. 2014;44(12a):1205-1209. doi:10.1111/imj.12542

4. Andres DW. Transesophageal diaphragmatic pacing for treatment of persistent hiccups. Anesthesiology. 2005;102(2):483. doi:10.1097/00000542-200502000-00040

5. Steger M, Schneemann M, Fox M. Systemic review: the pathogenesis and pharmacological treatment of hiccups. Aliment Pharmacol Ther. 2015;42(9):1037-1050. doi:10.1111/apt.13374