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Immediate Effects of Osteopathic Manipulative Treatment on Chest Wall Excursion and Spirometric Measures in Healthy Adults: A Randomized Sham-Controlled Trial

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Abstract

Background

Breathing mechanics are influenced by coordinated motion of the ribs, thoracic spine, sternum, diaphragm, and associated musculature. Chest wall excursion is a tape-measured estimate of thoracic mobility and may reflect restrictions in thoracic and rib motion. Osteopathic manipulative treatment (OMT) directed at thoracic and rib somatic dysfunction may influence these mechanics. The immediate effects of an individualized thoracic- and rib-directed OMT strategy on chest excursion and spirometric measures in healthy adults remain incompletely characterized.

Methods

This exploratory randomized sham-controlled study included 41 healthy volunteers assigned to individualized OMT (n = 22) or light-touch sham (n = 19). Upper chest excursion at the manubrial level (M1) and lower chest excursion at the xiphoid level (M2) were measured before and during the same visit shortly after intervention. The OMT strategy could include muscle energy, myofascial release, rib raising, and facilitated positional release. The study record reports a computer-generated allocation process and a light-touch comparator. Participant-level data and complete spirometric results were not available for additional analysis in this revision.

Results

The study record reports that mean M1 in the OMT group increased from 2.77 inches (standard error of the mean (SEM) 0.335) before intervention to 3.36 inches (SEM 0.319) during the same visit after intervention (reported p = 0.007 for the within-group comparison). The reported exploratory combined M1 + M2 change was 1.000 inch (SEM 0.316) in the OMT group and -0.053 inches (SEM 0.367) in the light-touch group (reported p = 0.035). Complete numerical forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and ratio of FEV1 and FVC (FEV1/FVC) results were not available; therefore, no effect estimate or conclusion about spirometric change is presented.

Conclusions

In healthy adults, the reported results provide only an exploratory same-visit difference in tape-measured chest excursion after an individualized OMT strategy. They do not establish a physiological mechanism, a durable effect, a spirometric effect, or clinical benefit. Confirmation requires a prospectively registered study with complete outcome data, a prespecified analysis plan, standardized measurement procedures, and blinded outcome assessment.

Categories: Osteopathic Medicine, Integrative/Complementary Medicine, Pulmonology
Keywords: breathing mechanics, chest wall excursion, healthy adults, osteopathic manipulative treatment, osteopathic medicine, pulmonary function, randomized controlled trial, somatic dysfunction, spirometry, thoracic mobility

Introduction

Efficient respiration depends on coordinated movement of the thoracic cage, ribs, sternum, thoracic spine, diaphragm, and intercostal musculature. Somatic dysfunction affecting these structures may alter regional mobility and the mechanical contribution of the chest wall to ventilation [1]. Chest excursion measured with a cloth tape is an inexpensive method of estimating thoracic mobility and has demonstrated acceptable reliability when performed by trained examiners [2]; reliability under the conditions of the present study was not documented. Reduced chest wall mobility has also been associated with impaired respiratory mechanics and lower forced vital capacity in selected clinical populations [3,4].

Osteopathic manipulative treatment (OMT) directed at the thorax, ribs, and diaphragm has been studied in healthy participants and in patients with respiratory disease, with mixed effects across chest mobility, diaphragmatic motion, and spirometric outcomes [5-11]. Prior studies have reported increases in thoracic excursion or diaphragmatic mobility after manual treatment, whereas changes in forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and their ratio have been inconsistent (FEV1/FVC) [5,6,9-11].

The present study evaluated same-visit changes after individualized thoracic- and rib-directed OMT compared with light touch in healthy adults. Upper chest excursion was measured at the manubrial level (M1), and lower chest excursion was measured at the xiphoid level (M2). The ClinicalTrials.gov record was posted after study completion and lists chest excursion, FVC, FEV1, and FEV1/FVC among its outcome measures, without a documented analytic hierarchy in the records available for this revision. Accordingly, all efficacy comparisons, including the derived combined M1 + M2 score, are interpreted as exploratory. The study hypothesis was that OMT would increase tape-measured chest excursion during the same visit.

Materials And Methods

Study design, setting, and ethics

This randomized sham-controlled trial was conducted at Touro College of Osteopathic Medicine (TouroCOM) in Harlem, New York City, NY, USA, by student investigators and faculty members of the Department of Osteopathic Manipulative Medicine. The Touro Health Sciences Institutional Review Board approved the study (HSIRB approval number 2024). Informed consent was obtained from all participants before enrollment. The study is registered at ClinicalTrials.gov under NCT04975542.

Participants and eligibility

Healthy TouroCOM students and employees were recruited as volunteers. Exclusion criteria included a history of obstructive or restrictive lung disease, recent trauma or illness, chest wall abnormalities, abnormal screening measurements, improper spirometer technique, or high variability among repeated measurements. Screening measurements included heart rate and oxygen saturation obtained using a CMS-50DL fingertip pulse oximeter (Contec Medical Systems Co., Ltd., Qinhuangdao, Hebei, China) and respiratory rate determined by counting breaths for 15 seconds and multiplying by four. Forty-eight volunteers were recruited and screened for eligibility. Seven were excluded before randomization, leaving 41 participants represented in the study records: 19 assigned to light-touch sham and 22 assigned to individualized OMT. A criterion-specific exclusion log was not retained.

Osteopathic structural examination and interventions

Before intervention, participants underwent an osteopathic structural examination of the thoracic spine and ribs. The thoracic examination assessed tissue texture abnormality, asymmetry, restriction of motion, and tenderness, including type I and type II thoracic somatic dysfunctions. Rib cage mechanics were evaluated for inhalation or exhalation somatic dysfunction involving pump-handle and bucket-handle motion of the upper, middle, and lower ribs.

Participants assigned to OMT received treatment individualized to the diagnosed thoracic and rib somatic dysfunction. The treatment strategy could include muscle energy, myofascial release, rib raising, and facilitated positional release techniques. The available study documentation does not identify the technique or techniques delivered to each participant, their sequence, anatomical targets, duration, dose, number of techniques, or selection criteria. Participants assigned to the light-touch sham received gentle placement of the investigator's hands over the rib cage and thoracic spine without applied pressure for several minutes. Documentation did not establish whether contact time was matched to the OMT session. Second-year osteopathic medical students performed the examinations and interventions under supervision of a licensed osteopathic physician. Measurements were repeated during the same visit shortly after OMT or light-touch sham. The utility of a sham protocol has been evaluated in prior OMT research [12].

Randomization

After consent and screening, participants were assigned using a computer-generated application program. Odd-numbered assignments were allocated to the light-touch sham group and even-numbered assignments to the OMT group; the study records identify 19 participants in the light-touch group and 22 in the OMT group. The available records do not identify the software, numeric range, duplicate handling, timing of sequence generation, allocation-concealment method, or separation of recruitment, enrollment, and assignment roles. Participant masking was intended through the light-touch comparator, but sham credibility and participants' treatment guesses were not assessed. Treating practitioners were aware of group assignment; the available records do not establish whether outcome assessors or statistical analysts were separate from treating practitioners or masked.

Chest excursion and spirometric measurements

Upper and lower chest excursion were measured with a body tape. Upper chest excursion (M1) was measured at the center of the manubrium, and lower chest excursion (M2) was measured at the level of the xiphoid process. Chest-excursion values were recorded in inches and repeated during the same visit shortly after the assigned intervention. Participant position, breathing instructions, tape tension, number of trials, examiner assignment and training, within-study reliability, and whether the same or a masked examiner performed pre-intervention and post-intervention measurements were not retained in the available study documentation.

Pulmonary function was assessed using a Spirobank II Advanced spirometer (MIR Srl, Rome, Italy). The study record states that each participant completed three maneuvers characterized as acceptable before and after intervention and that FEV1 and FVC were averaged to calculate FEV1/FVC. Spirometer calibration, contemporary acceptability and repeatability criteria, quality-control records, and the rationale for averaging rather than selecting values were not available for this revision. Contemporary American Thoracic Society/European Respiratory Society recommendations emphasize acceptability, repeatability, and reporting the largest acceptable FEV1 and FVC values [13].

Sample-size determination

The study was an exploratory, single-center investigation. No a priori sample-size calculation or contemporaneous rationale for the target sample was located in the records available for this revision. Forty-eight volunteers were screened, and 41 participants were represented in the study records: 19 in the light-touch group and 22 in the OMT group. The retrospectively posted registry lists multiple outcome measures, including chest excursion, FVC, FEV1, and FEV1/FVC, but the available records do not document an analytic hierarchy or multiplicity plan. The combined M1 + M2 change score is a derived exploratory outcome.

Statistical analysis

The study documentation states that data were analyzed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA), with two-tailed paired-samples t-tests for within-group changes and two-tailed independent-samples t-tests for group comparisons. Statistical significance was set at $p < 0.05$. A combined chest-excursion change score was calculated by summing each participant's net change in M1 and M2. Participant-level data and complete original statistical output were not available for additional analysis in this revision. Accordingly, this manuscript does not present SDs, confidence intervals, t-statistics, pooled-variance calculations, variance assessments, or baseline-adjusted estimates derived from rounded aggregate values. Reported p-values are retained as reported in the study documentation.

Results

Participant flow and characteristics

Forty-eight volunteers were assessed for eligibility. Seven were excluded before randomization because they did not meet one or more eligibility or baseline measurement-quality criteria; the number attributable to each criterion was not separately retained. The study records identify 41 participants, with 19 assigned to light-touch sham and 22 assigned to individualized OMT (Figure *1*). The available records do not contain a participant-level post-allocation flow log. Baseline participant characteristics and reported chest-excursion values are summarized in Table *1*.

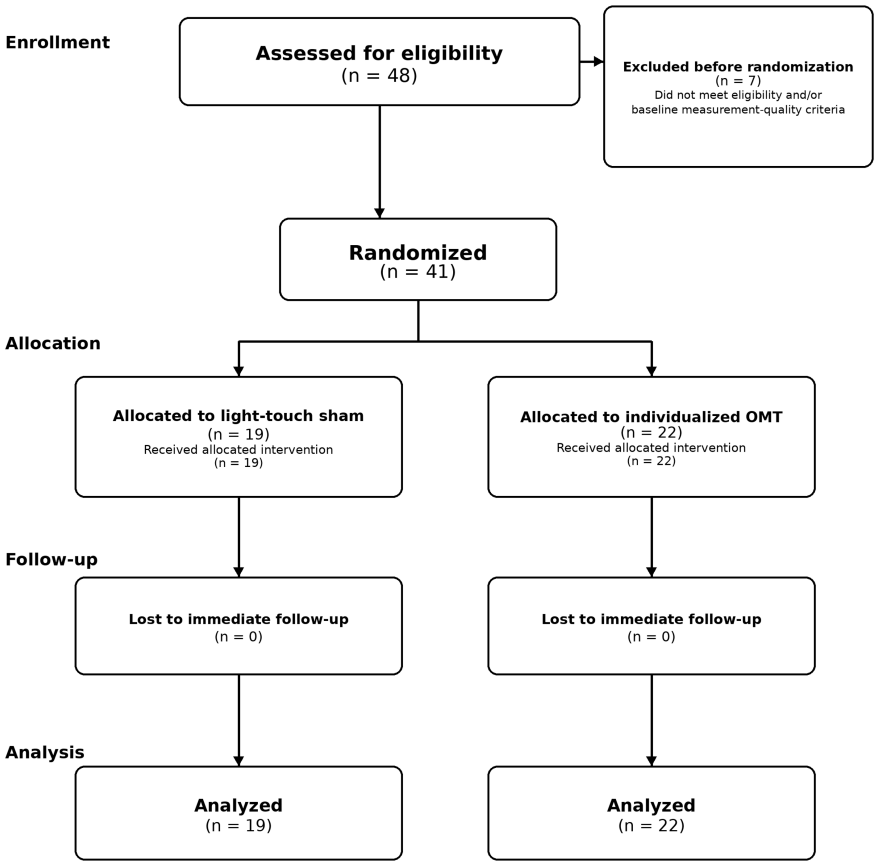


FIGURE 1: Participant flow

Forty-eight volunteers were assessed for eligibility. Seven participants were excluded before randomization for one or more eligibility or measurement-quality criteria, including pulmonary disease, recent trauma or illness, chest-wall abnormality, abnormal screening measurements, inadequate spirometry technique, or excessive variability among repeated measurements. The number of exclusions attributable to each individual criterion was not retained. The study records identify 41 participants: light-touch sham (n = 19) and individualized osteopathic manipulative treatment (n = 22). A participant-level post-allocation flow log was not available.

OMT: osteopathic manipulative treatment.

Characteristic	Light-touch sham	OMT
Participants, n	19	22
Age range, years	22–38	24–32
Male participants, n (%)	4 (21.1)	11 (50.0)
Female participants, n (%)	15 (78.9)	11 (50.0)
Baseline M1, mean, inches	3.29	2.77
Baseline M2, mean, inches	3.81	2.92

TABLE 1: Participant characteristics and baseline chest-excursion values reported in the study documentation

Complete baseline spirometric summary values and variability estimates were not available for inclusion.

M1: upper chest excursion measured at the manubrium; M2: lower chest excursion measured at the xiphoid process; OMT: osteopathic manipulative treatment.

Chest excursion

In the OMT group (n = 22), the reported mean M1 was 2.77 inches (standard error of the mean (SEM) 0.335) before intervention and 3.36 inches (SEM 0.319) during the same visit after intervention; the study documentation reports p = 0.007 for this within-group comparison. Baseline mean M1 was 3.29 inches in the light-touch group. Baseline mean M2 was 3.81 inches in the light-touch group and 2.92 inches in the OMT group. M2 increased numerically following OMT but was not reported as independently statistically significant. Because participant-level data were unavailable, this within-group comparison is not presented as a baseline-adjusted estimate of OMT superiority over light touch (Figure *2* and Table *2*).

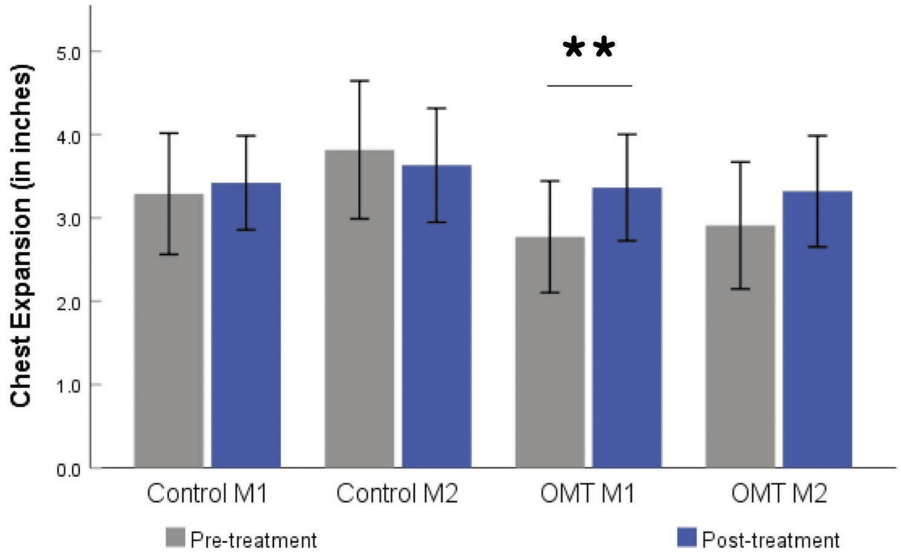


FIGURE 2: Chest excursion before and after intervention by group

Bars show the reported means for upper chest excursion at the manubrium (M1) and lower chest excursion at the xiphoid process (M2) before and during the same visit after intervention. Error bars represent the standard error of the mean. The study documentation reports p = 0.007 for the pre-intervention versus post-intervention M1 comparison within the OMT group. This within-group result is not a baseline-adjusted between-group estimate. M2 was not reported as independently statistically significant.

OMT: osteopathic manipulative treatment.

Reported OMT M1 value	Value
Participants	22
Pre-intervention mean (SEM), inches	2.77 (0.335)
Post-intervention mean (SEM), inches	3.36 (0.319)
Reported within-group p value	0.007

TABLE 2: Reported M1 values in the OMT group

The p-value is retained as reported in the study documentation. Participant-level data and original statistical output were not available for additional analysis.

M1: upper chest excursion measured at the manubrium; OMT: osteopathic manipulative treatment; SEM: standard error of the mean.

The study documentation reports an exploratory combined M1 + M2 change of -0.053 inches (SEM 0.367) in the light-touch group (n = 19) and 1.000 inch (SEM 0.316) in the OMT group (n = 22), with a reported p-value of 0.035 for the between-group comparison. Because this combined score was derived, lacks a prespecified biological or statistical justification, and cannot be reassessed with participant-level data, it is not treated as a confirmatory outcome or as a substitute for separate baseline-adjusted M1 and M2 comparisons (Figure *3* and Table *3*).

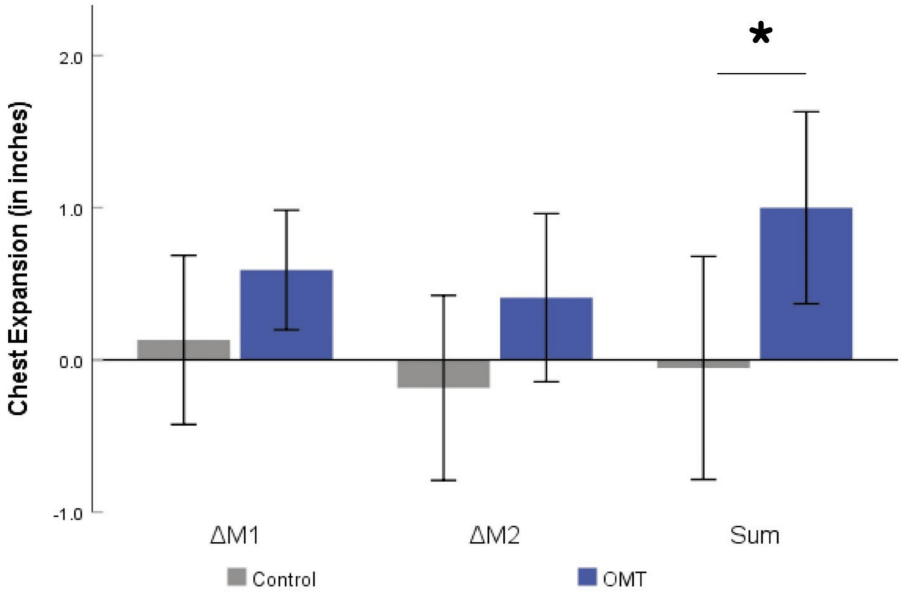


FIGURE 3: Net change in chest excursion by group

Bars show reported net changes in upper chest excursion at the manubrium (M1), lower chest excursion at the xiphoid process (M2), and the derived combined M1 + M2 score. Error bars represent the standard error of the mean. The reported combined change was 1.000 inch (SEM 0.316) in the OMT group and -0.053 inches (SEM 0.367) in the light-touch group; the study documentation reports p = 0.035 for this exploratory comparison. The combined score is not a prespecified primary outcome and is not interpreted as confirmatory.

OMT: osteopathic manipulative treatment; SEM: standard error of the mean.

Exploratory outcome	Light-touch sham	OMT	Reported p-value
Combined M1 + M2 change, inches	n = 19; -0.053 (SEM 0.367)	n = 22; 1.000 (SEM 0.316)	0.035

TABLE 3: Reported exploratory combined M1 + M2 change

The combined score is derived and exploratory. The p-value is retained as reported in the study documentation; participant-level data were not available for a baseline-adjusted analysis.

M1: upper chest excursion measured at the manubrium; M2: lower chest excursion measured at the xiphoid process; OMT: osteopathic manipulative treatment; SEM: standard error of the mean.

Spirometric findings

Complete group-specific pre-intervention and post-intervention values for FVC, FEV1, and FEV1/FVC were not available for inclusion. The study documentation reports no statistically significant FEV1/FVC difference within either group or between groups. In the absence of complete numerical data, effect estimates, and original output, this statement is not interpreted as evidence of no spirometric effect. No unavailable values were estimated or imputed.

Adverse events

No adverse events were documented during any portion of this study.

Discussion

This exploratory randomized sham-controlled study reports a same-visit increase in M1 within the OMT group and a between-group difference in the derived combined M1 + M2 score. These observations do not establish OMT superiority over light touch. The M1 finding is a within-group comparison; the combined score was derived, and original participant-level data were unavailable for separate baseline-adjusted M1 and M2 analyses. Baseline M1 and M2 were lower in the OMT group in the reported summaries, so baseline imbalance and regression to the mean remain plausible alternative explanations for unadjusted change patterns.

Tape-measured excursion is not a direct measure of a physiological or biomechanical mechanism. The observations may reflect transient changes in posture, effort, familiarity with testing, assessor technique, or other factors, and the individualized intervention does not permit attribution to any specific OMT technique. The findings do not establish a durable physiological effect or clinical benefit.

The available study documentation reports no statistically significant FEV1/FVC difference, but complete numerical FEV1, FVC, and FEV1/FVC data were unavailable. Accordingly, the study does not support a conclusion that OMT did or did not affect spirometric pulmonary function. Earlier OMT studies have reported mixed respiratory findings [5,6,9-11], but the present results should remain limited to an exploratory same-visit observation in healthy volunteers.

Limitations

This study was small, single-center, and conducted in healthy volunteers, which limits generalizability. The record was posted on ClinicalTrials.gov after study completion and lists multiple outcome measures without a documented analytic hierarchy or multiplicity plan. The combined M1 + M2 score was derived and exploratory. Baseline M1 and M2 were lower in the OMT group in the available summaries, and neither baseline-adjusted analyses nor variance assessments could be performed because participant-level data and complete original output were unavailable. These issues create risks of baseline imbalance, regression to the mean, selective outcome emphasis, and false-positive findings.

The available records do not document allocation concealment, sham credibility, participant treatment guesses, assessor masking, role separation, detailed treatment fidelity, contact-time matching, or key tape-measurement conditions. The spirometry documentation does not permit verification of calibration, contemporary quality-control criteria, or complete group-specific results. The registry describes the upper chest landmark and unit differently from the manuscript source materials: sternal notch in centimeters versus center of the manubrium in inches. That discrepancy remains unresolved. Outcome timing was intended to be within five minutes in the registry, but participant-specific elapsed intervals were not retained. Adverse-event reporting was also not systematically documented. Together, these limitations restrict causal interpretation.

Future research should prospectively register an analytic hierarchy, retain complete participant-level outcome data, use a standardized and documented intervention and sham protocol, prespecify baseline-

adjusted analyses, use blinded outcome assessment, document measurement procedures and spirometry quality control, and include follow-up and patient-important outcomes.

Conclusions

In this exploratory randomized sham-controlled study of healthy adults, the reported results describe a same-visit difference in tape-measured chest excursion after an individualized thoracic- and rib-directed OMT strategy. They do not establish a physiological mechanism, a durable effect, a spirometric effect, or clinical benefit. Because the positive between-group result concerns a derived exploratory score and original participant-level data were unavailable for baseline-adjusted analyses, the findings require confirmation in a prospectively registered study with complete outcome reporting, standardized procedures, and blinded outcome assessment.

Despite these limitations, the study is relevant because it addresses an important and clinically practical question: whether an individualized thoracic- and rib-directed OMT strategy can produce immediate, measurable changes in tape-measured chest excursion. Its randomized, sham-controlled design and use of a simple bedside measure provide valuable preliminary data in an area where the immediate effects of OMT on thoracic mobility remain incompletely characterized. The observed same-visit difference supports continued investigation of OMT as a potentially useful strategy for influencing chest wall excursion and provides a foundation for larger studies using standardized protocols, pre-specified analyses, blinded outcome assessment, complete outcome reporting, and follow-up to determine reproducibility and clinical relevance.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Acquisition, analysis, or interpretation of data: Abraham E. Libman, Mikhail Volokitin, Susan Milani, Mary Banihashem

Drafting of the manuscript: Abraham E. Libman, Mikhail Volokitin

Critical review of the manuscript for important intellectual content: Abraham E. Libman, Mikhail Volokitin, Susan Milani, Mary Banihashem

Concept and design: Mikhail Volokitin

Supervision: Mikhail Volokitin, Susan Milani, Mary Banihashem

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Touro Health Sciences Institutional Review Board issued approval (HSIRB #2024). The study was approved on August 16, 2019 (HSIRB #2024), prior to participant enrollment. Informed consent was obtained from all participants before enrollment. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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