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Workforce resilience supporting staff in managing stress: A coherent breathing intervention for the long-term care workforce

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Abstract

Background: Staff in long-term care (LTC) homes have long-standing stressors, such as short staffing and high workloads. These stressors increased during the COVID-19 pandemic; better resources are needed to help staff manage stress and well-being. The purpose of this study was to evaluate the effect of a simple stress management strategy (coherent breathing).

Methods: We conducted a pre–post intervention study to evaluate a self-managed coherent breathing intervention from February to September 2022. The intervention included basic (breathing only) and comprehensive (breathing plus a biofeedback device) groups. Six hundred eighty-six participants were initially recruited (359 and 327 in the comprehensive and basic groups respectively) from 31 LTC homes in Alberta, Canada. Two hundred fifty-four participants completed pre-and post-intervention questionnaires (142 [55.9%] in comprehensive and 112 [44.1%] in basic). Participants were asked to use coherent breathing based on a schedule increasing from 2 to 10 min daily, 5–7 times a week over 8 weeks. Participants completed self-administered online questionnaires pre- and post-intervention to assess outcomes—stress, psychological distress, anxiety, depression, resilience, insomnia, compassion satisfaction, compassion fatigue, and burnout. We used a mixed-effects regression model to test the main effect of

time (pre- and post-intervention) and group while testing the interaction between time and group and controlling for covariates.

Results: We found statistically significant changes from pre- to post-intervention in stress ($b = -2.5$, $p < 0.001$, 95% CI $= -3.1, -1.9$), anxiety ($b = -0.5$, $p < 0.001$, 95% CI $= -0.7, -0.3$), depression ($b = -0.4$, $p < 0.001$, 95% CI $= -0.6, -0.2$), insomnia ($b = -1.5$, $p < 0.001$, 95% CI $= -2.1, -0.9$), and resilience ($b = 0.2$, $p < 0.001$, 95% CI $= 0.1, 0.2$). We observed no statistically significant differences between the two intervention groups on any outcome.

Conclusions: Our findings suggest that coherent breathing is a promising strategy for improving stress-related outcomes and resilience. This intervention warrants further, more rigorous testing.

KEYWORDS

coherent breathing, healthcare aide, long-term care, mental health, staff well-being

INTRODUCTION

Over the past years, staff in long-term care (LTC) homes have faced significant stressors and challenges, including short staffing, aggression from residents, and increased workloads.[1–3] These stressors were compounded during the COVID-19 pandemic, as staff faced additional challenges such as fear of infection, resident isolation, death of residents, and increased infection control protocols. Studies report increased insomnia, stress, depression, and anxiety in LTC staff during the pandemic.[4–8]

Managers, nurses, and care aides in LTC homes care for vulnerable older adults, often in their last stages of life, most of whom have some form of dementia. Of these staff members, care aides provide upwards of 90% of the direct care. Most care aides are middle-aged older women, immigrants, and speak English as their second language.[1,2,9] To maintain their mental and physical health and deliver quality care to residents, these essential workers need simple, effective strategies to help manage workplace stress and overall well-being.[4–8] In qualitative studies conducted by our team during the COVID-19 pandemic, staff emphasized an urgent need for an intervention and requested practical strategies.[4,8] At the same time, policymakers and managers were interested in supporting the evaluation of interventions that could be implemented without undue delay or cost.

Coherent breathing is a simple, free, and accessible structured technique that involves breathing through the nose deep into the belly with equal inhalations and exhalations to a count of 4, 5, or 6.[10–12] Coherent breathing activates the parasympathetic nervous system and downregulates the sympathetic nervous system, synchronizing the heart rate and breathing (becoming coherent), reducing heart rate and blood pressure and increasing heart rate variability.[10–12] Recent randomized controlled trials and systematic reviews associate coherent breathing (and similar techniques) with many outcomes, including improvements in depression, anxiety, and overall well-being.[10,11,13,14] These improvements can potentially

Key points

- Healthcare workers in long-term care have long-standing stressors and need strategies to help manage workplace stress and maintain well-being.
- The intervention, coherent breathing, is a simple strategy previously found to improve mental and physical health.
- Improvements in stress, psychological distress, and other mental health outcomes were found following the eight-week intervention for staff in long-term care homes.

Why does this paper matter?

Staff in long-term care homes have faced increasing stressors over the COVID-19 pandemic and require strategies to help manage their workplace stress and well-being. Improving the stress of the staff in long-term care is essential both for their quality of work-life and for the residents who rely on them to provide quality care. This paper describes a simple, no-cost intervention, coherent breathing, which we found to help improve measures of stress and other health outcomes, including insomnia. This paper provides a foundation for future clinical research focused on improving the well-being of staff in long-term care homes.

influence quality of work-life and health outcomes, including burnout and insomnia.[10,11,13] Studies using similar breathing interventions for healthcare staff *during* COVID-19 included a pilot and a quasi-experimental study, both using a pre-post design. Both identified potential improvements in sleep, stress, anxiety, and depression; however, neither were conducted in LTC.[15,16]

We located no literature reporting the effects of coherent breathing for LTC staff. As this is a diverse group consisting primarily of racialized immigrant women who provide essential services to vulnerable older adults and continue to face ongoing work stressors unique to their jobs and the LTC setting, evaluating the strategy with them is an important step. This study aimed to evaluate a coherent breathing intervention combined with a brief stress education program for staff working in LTC settings in Alberta, Canada, in 2022.

METHODS

Design

We conducted a pre–post two-group intervention (with no control group) evaluation between February and September 2022.

The intervention

The intervention had three components:

- An orientation session before the education session to discuss the project timeline and details.
- A 30-minute stress management education session before beginning coherent breathing.
- Coherent breathing for 8 weeks after the education session.
- Optional virtual support sessions.

Education session

The session included information about stress and the body's response to stress. During this session, participants learned grounding techniques to notice how they are breathing and where they are holding tension in their bodies before completing coherent breathing.[10,12,14]

Coherent breathing

Participants were taught to breathe slowly into their belly to a count of 4, 5, or 6 (depending on what was comfortable) and exhale with an even flow using the same steady count.

Frequency and duration

Participants were given a schedule and encouraged to complete one breathing session daily, five to seven times a week, gradually increasing from 2 to 10 min per session over 8 weeks. This schedule was created using previous literature[10,12,14] that focused on similar breathing interventions and consultation with two team members who are psychiatrists, one specializing in trauma.

Intervention groups

The *basic group* completed the intervention with breathing only. The *comprehensive group* completed the breathing intervention with a biofeedback device (HeartMath Inner Balance Monitor), which they kept after study completion.[17] This monitor is placed on the participant's ear and connects to an app on their mobile phone to provide real-time feedback on their breathing, heart rate, and heart rhythm. This device has been used in mindfulness practices, allowing participants to visualize their progress.[17,18]

Setting

This project occurred in 31 LTC homes in Alberta, Canada.

Sample

LTC home sample and recruitment

LTC homes were recruited as a convenience sample using email and phone calls with LTC managers, directors of care, and organizational directors. Homes were allocated to intervention groups based on when they could start the project. The homes who agreed to participate first could choose whether to go into the comprehensive or basic group.

Following the recruitment of the homes, managers chose a "home liaison", who could be any staff member. This liaison was the primary contact with the research team.

Participant eligibility criteria

Participants were care aides, registered nurses (RN), licensed practical nurses (LPNs), or managers with access to a smartphone, tablet, or laptop with internet to connect to Zoom.[19]

Participant sample and recruitment

Home liaisons recruited participants using posters provided by the research team. They collected the names and email addresses of participants who volunteered and sent them to the research team.

Remuneration

Participating LTC homes received a $500 stipend to cover minor expenses associated with participation, providing a liaison, staff recruitment and distribution of materials. Participants received a $5 coffee gift card at the beginning of the project and a $50 grocery gift card following the project to thank them for their time.

Procedures

Sessions

Participants received a printed welcome package with instructions on joining the orientation and education sessions at the beginning of the intervention. We used Zoom[19] to provide the sessions hosted by a trained research assistant. We offered additional support meetings to help with questions about the breathing technique or technological challenges. Sessions were scheduled multiple times a week at different times (morning, evening, and night) to accommodate shift work. Participants who could not attend a session were provided with a link to a recording. Research assistants emailed participants during week four of breathing practice and hosted an optional check-in Zoom[19] session to answer questions and see how breathing practice was progressing.

Surveys

Survey measures capturing mental and physical health and quality of work-life outcomes were administered before the education session and after the 8-weeks of breathing. A short knowledge test was administered before and after the education session and after the 8-weeks of breathing. Participants received links to the questionnaires via email and were asked to complete them independently online via REDCap.[20]

Adherence (Fidelity)

Intervention adherence (fidelity enactment), specifically the number of daily breathing practices per week compared to our recommended weekly schedule, was obtained from daily participant paper-based diaries.

Measures

Mental health, stress, and anxiety outcomes

Stress

Perceived Stress Scale (PSS-10), a 10-item valid and reliable scale measuring feelings of self-perceived stress within the last month. Stress level is calculated as the sum of scores; higher scores indicate higher stress (range 0–40).[21–23]

Psychological distress, anxiety, and depression

Patient Health Questionnaire (PHQ-4),[24,25] a 4-item Likert scale. The sum of all items indicates the score of psychological distress; a higher score suggests higher distress (range 0–12). Anxiety and depression are scored by the sum of two items each (range 0–6).[24,25]

Health and work-life quality outcomes

Insomnia

Insomnia Severity Index (ISI), a 7-item Likert scale measuring sleep patterns in the last 2 weeks. The sum of the seven items is calculated; higher scores indicate more severe clinical insomnia (range 0–28).[26–30]

Resilience

Brief Resilience Scale (BRS)[31] is a 6-item measure of resilience through stressful events. For an overall score, three scale items are reverse scored, and the mean of all items is calculated. A higher score indicates higher resilience levels (range 6–30).[31]

Professional quality of life

Professional Quality of Life Assessment (ProQoL-9)[32–35] has 3 subscales of 3 items each – compassion fatigue (ProQoL-CF), compassion satisfaction (ProQoL-CS), and burnout (ProQoL-BO). Respondents are asked to look back over the last 30 days. Each sub-scale is on a 5-point Likert scale; scores per subscale range from 3 to 15.[32–35]

Knowledge test

We developed a 12-item true/false and multiple-choice test to evaluate the potential change in the participant's knowledge of stress at the three-time intervals (pre- and post-education and follow-up after the 8-week intervention).

Analysis

We used descriptive statistics (frequencies, percentages, means, and standard deviations) to describe variables and repeated measures ANOVA to test cross-time changes (pre-, post- and one follow-up) in knowledge test scores. We used a mixed-effects linear regression model, specifically a random intercept model, for each outcome to test the main effects of time (pre-and post-intervention) and group (comprehensive vs basic) on the outcome. This resulted in a series of nine models, one for each outcome. Mixed-effects linear regression models account for correlations between repeated measurements within each participant. We added a time-by-group interaction to the model to test whether pre–post outcome scores differed by group (comprehensive vs basic group). The mixed-effects linear regression models controlled for multiple covariates (see Supplemental Material S1). The covariates were time-invariant (as covariates were collected in the pre-intervention questionnaire only) and were considered potential confounders that may be associated with group assignment based on discussions among the research team, current literature, and statistical associations among variables. We calculated standardized outcomes, *Z*-Zscores (variable-mean/standard deviation) to allow for comparisons of pre-post changes between various outcomes. Our regression analysis used the *z*-scores and original outcome scores separately as dependent variables. The *p*-value was adjusted with Bonferroni's correction to control for multiple hypothesis tests. The adjusted *p*-value for significance was $p < 0.006$.

A sensitivity analysis using calculated adherence scores and time-by-adherence interaction was completed using our regression model to determine if pre-post outcomes differed by adherence score and if adherence biased our regression results. Analyses of the data were completed in SPSS and SAS.[36,37]

Ethics

Ethical approval was obtained from the University of Alberta Research Ethics Board (Pro00106029). Additional operational approval was obtained from the participating organizations. Participants completed written consent forms prior to their participation.

RESULTS

Six hundred eighty-six (686) participants were initially recruited for the intervention: 359 in the comprehensive group (with biofeedback device) and 327 in the basic group. Of the 686 initial participants, 383 completed baseline (pre-intervention) measures and started coherent breathing; 254 completed the baseline measures, breathing intervention, and post-intervention measures, for an overall attrition rate of 63.0% (completion rate 37.0%). A comparison between individuals who only completed the baseline measures ($n = 129$) and those who completed all measures ($n = 254$) can be found in Supplemental Material S2. Of the 303/686 individuals who did not complete the baseline measures, we do not have data. Of the 254 who completed pre- and post-study questionnaires, 142 (55.9%) were in the comprehensive group, and 112 (44.1%) were in the basic group.

Demographics

LTC home characteristics, participant demographics, and health habits are found in Table 1. Among the 254 participants, 126 (49.6%) were care aides, 98 (38.6%) were nurses, and 30 (11.8%) were managers. Most participants were female ($n = 227$, 90.1%), aged 30–49 ($n = 154$, 61.1%), born outside of Canada ($n = 166$, 67.2%), and spoke English as a second language ($n = 150$, 59.3%).

Reasons for not completing the study

We conducted a short survey of participants who did not complete the intervention (37 responses). Three main reasons for not completing project components were identified: (i) personal circumstances such as ill-health (8), (ii) other commitments such as family and work (21), and (iii) project inaccessibility such as time and effort needed to participate or technical issues (11). These results align with reasons for drop-outs sent via email by individuals who officially withdrew.

Adherence

Of the 254 participants, 116 (81.7%) of the 142 from the comprehensive group and 76 (67.9%) of the 112 from the basic group completed breathing diaries. The comprehensive group participants completed breathing sessions, on average, 5 days per week, reaching a mean duration of 9.3 min per session by Week 8. Participants in the basic group completed breathing on average 5.7 days per week, reaching a mean duration of 9.4 min by Week 8. Among the 192 individuals who completed breathing diaries, on average, both groups completed the recommended 5–7 sessions per week and reached or almost reached the recommended duration of 10 min by Week 8.

TABLE 1 Demographics of participants and characteristics of long-term care homes (Time 1).

Participant characteristics ($n = 254$)			
	Comprehensive	**Basic**	**Total**
Group *n* (%)	142 (55.9)	112 (44.1)	254 (100)
Sex	*n* (%)	*n* (%)	*n* (%)
Male	16 (11.4)	8 (7.1)	24 (9.5)
Female	124 (88.6)	103 (92.0)	227 (90.1)
Other	0 (0)	1 (0.9)	1 (0.4)
Age range (years)	*n* (%)	*n* (%)	*n* (%)
<30	10 (7.1)	8 (7.1)	18 (7.1)
30–39	38 (27.1)	24 (30.4)	72 (28.6)
40–49	46 (32.9)	36 (32.1)	82 (32.5)
50–59	33 (23.6)	24 (21.4)	57 (22.6)
>60	13 (9.3)	10 (8.9)	23 (9.1)
English as a first language	*n* (%)	*n* (%)	*n* (%)
Yes	46 (32.6)	57 (50.9)	103 (40.7)
No	95 (67.4)	55 (49.1)	150 (59.3)
Cultural/Racial groups	*n* (%)	*n* (%)	*n* (%)
Filipino	59 (42.1)	21 (19.1)	80 (32.0)
White	32 (22.9)	51 (46.4)	83 (33.2)
Other	49 (35.0)	38 (34.5)	87 (34.8)
Role	*n* (%)	*n* (%)	*n* (%)
Care aide	85 (59.9)	41 (36.6)	126 (49.6)
Nurse (RN/LPN)	43 (30.3)	55 (49.1)	98 (38.6)
Manager	14 (9.9)	16 (14.3)	30 (11.8)
Hours of housework	*n* (%)	*n* (%)	*n* (%)
0–2 hours	42 (30.0)	55 (49.1)	97 (38.5)
2+ hours	98 (70.0)	57 (50.9)	155 (61.5)
Shift worked most of the time	*n* (%)	*n* (%)	*n* (%)
Day shift (between 0700 and 2000)	80 (57.6)	77 (68.8)	157 (62.5)
Other (start after 1400, rotating shifts)	59 (42.4)	35 (31.3)	94 (37.5)
Hours worked in 2 weeks	Mean (SD)	Mean (SD)	Mean (SD)
Hours worked	62.1 (19.9)	62.2 (24.5)	62.2 (22.0)
Time worked in current role	Mean (SD)	Mean (SD)	Mean (SD)
Years	10.8 (15.0)	9.4 (8.6)	10.2 (12.6)
Multi-habit	Mean (SD)	Mean (SD)	Mean (SD)
Number of habits (0–4)	0.3 (0.6)	0.4 (0.7)	0.3 (0.6)
Multi-coping strategies	Mean (SD)	Mean (SD)	Mean (SD)
Number of coping strategies (0–5)	0.8 (0.8)	1.1 (1.1)	0.9 (1.0)
Long-term care home characteristics ($n = 31$)			
Care home characteristic	Total		
Group	*n* (%)		
Comprehensive	13 (41.9)		
Basic	18 (58.1)		

TABLE 1 (Continued)

Participant characteristics ($n = 254$)			
	Comprehensive	**Basic**	**Total**
Region	*n* (%)		
Edmonton	18 (58.1)		
Calgary	8 (25.8)		
Other	5 (16.1)		
TREC vs. non-TREC	*n* (%)		
TREC	18 (58.1)		
Non-TREC	13 (41.9)		
Facility-ownership type	*n* (%)		
Public	6 (19.4)		
Private	9 (29.0)		
Voluntary	16 (51.6)		
Facility size	*n* (%)		
Small (<80 beds)	6 (19.4)		
Medium (80–120 beds)	9 (29.0)		
Large (>120 beds)	15 (48.4)		
Other (long-term care organization)	1 (3.2)		

Note: One individual who selected other (sex) identifies as non-binary. 'Multi-Habit' is a sum of the yes scores on a select all apply question asking participants (yes = 1, no = 0) if they use alcohol, cannabis, tobacco, or sleeping aides. 'Multi-coping strategies' is a sum of participant yes responses to a select all that apply question asking (yes = 1, no = 0) if they participate in any of the following activities: Yoga, Tai Chi, Meditation, Church/Spiritual Activities or Other. TREC vs non-TREC: TREC homes were those that have previously participated in projects associated with our research team (Translating Research in Elder Care or TREC).

TABLE 2 Reported mental health scores pre- and post-intervention.

	Comprehensive group		**Basic group**	
	Pre-scores mean (SD)	**Post-scores mean (SD)**	**Pre-scores mean (SD)**	**Post-scores mean (SD)**
PSS-10	19.0 (4.9)	16.7 (5.0)	19.2 (5.1)	16.4 (4.9)
PHQ-4 Distress[a]	3.0 (2.6)	2.1 (2.4)	3.4 (2.9)	2.3 (2.7)
PHQ-4 Anxiety[a]	1.7 (1.5)	1.2 (1.4)	1.9 (1.6)	1.4 (1.6)
PHQ-4 Depression[a]	1.3 (1.3)	0.9 (1.2)	1.5 (1.6)	0.9 (1.4)
BRS	3.4 (0.6)	3.5 (0.6)	3.4 (0.6)	3.5 (0.6)
ISI	8.4 (5.0)	7.1 (4.7)	9.1 (5.5)	6.9 (5.1)
ProQoL-CF[b]	6.5 (2.4)	6.1 (2.1)	6.3 (2.3)	5.9 (2.2)
ProQoL-CS[b]	12.5 (2.2)	12.6 (2.2)	12.4 (1.9)	12.6 (5.1)
ProQoL-BO[b]	7.9 (2.7)	7.8 (2.6)	8.3 (2.6)	7.5 (2.5)

Abbreviations: BRS, brief resilience scale; ISI, insomnia severity index; PHQ-4, patient health questionnaire for anxiety and depression; ProQoL-BO, professional quality of life-burnout subscale; ProQoL-CF, professional quality of life-compassion fatigue subscale; ProQoL-CS, professional quality of life scale-compassion satisfaction subscale; PSS-10, perceived stress scale.

[a]3 scores are calculated for the PHQ-4: psychological distress (PD), depression, and anxiety. The PHQ-4 is a short form of the PHQ9 and is used as a brief screening scale.

[b]ProQoL Scales Interpretation: ProQoL-CS: higher score is higher professional compassion satisfaction, ProQoL-CF: higher score is higher compassion fatigue, ProQoL-BO: higher scores can be interpreted as higher levels of burnout.

Knowledge test

There were no statistically significant changes in the test scores from pre-education to post-education and after-the-eight-week follow-up for managers. Significant changes were observed between three time points for nurses and care aides; however, these changes were small with large confidence intervals (Supplemental Material

TABLE 3 Mixed-effects linear regression (adjusted findings), pre–post changes in the original scores of the outcome variable.

Mental health, health, and quality of work-life outcomes b(95% CI)									
	PSS-10	PHQ-4 Distress	PHQ-4 Anxiety	PHQ-4 Depression	BRS	ISI	ProQoL-CF	ProQoL-CS	ProQoL-BO
Time point									
Post-intervention (ref = pre)	−2.5*,** (−3.1, −1.9)	−0.9*,** (−1.3, −0.5)	−0.5*,** (−0.7, −0.3)	−0.4*,** (−0.6, −0.2)	0.2*,** (0.1, 0.2)	−1.5*,** (−2.1, −0.9)	−0.3* (−0.5, −0.003)	0.1 (−0.1, 0.4)	−0.4* (−0.7, −0.1)
Group									
Basic (ref = comp)	0.04 (−1.2, 1.2)	0.3 (−0.3, 0.9)	0.1 (−0.3, 0.4)	0.2 (−0.1, 0.5)	0.1 (−0.1, 0.2)	0.3 (−0.9, 1.4)	−0.4 (−0.9, 0.2)	−0.2 (−0.7, 0.4)	0.03 (−0.6, 0.7)

Note: The regression model adjusted for covariates including intervention group, age, sex, English as a first language, culture/race, role, hours of housework a day, shift worked most of the time, length worked in role (years), hours worked in 2 weeks, coping skills and activities (multiactivity variable), and habits (multihabit variable as sum of number of habits). The full regression findings are reported in Supplemental Material S1.
Abbreviations: BRS, brief resilience scale; Comp, comprehensive intervention group; ISI, insomnia severity index; PHQ-4, patient health questionnaire for anxiety and depression; ProQoL-BO, professional quality of life-burnout subscale; ProQoL-CF, professional quality of life-compassion fatigue subscale; ProQoL-CS, professional quality of life-compassion satisfaction subscale; PSS-10, perceived stress scale; Ref, reference variable in regression model.
*Statistically significant at 0.05 without *p*-value correction.
**Statistically significant at 0.006–Bonferroni's *p*-value correction for 9 outcome variables.

S3 and S4). Our baseline scores were high, suggesting we had a ceiling effect and that our test was not sufficiently sensitive.

Mental health outcomes

Pre- and post-intervention mental health and well-being scores from the 254 participants in both groups can be found in Table 2. The adjusted main effects model results can be found in Table 3.

Mental health, stress, and anxiety outcomes

Statistically significant improvements ($p < 0.006$) from pre-to-post were found in perceived stress (PSS-10, b = −2.5, $p < 0.001$, 95% CI = −3.1, −1.9), psychological distress (PHQ-4, b = −0.9, $p = 0.00$, 95% CI = −1.3, −0.5), anxiety (PHQ-4, b = −0.5, $p = 0.00$, 95% CI = −0.7, −0.3), and depression (PHQ-4, b = −0.4, $p = 0.00$, 95% CI = −0.6, −0.2).

Health and work-life quality outcomes

Statistically significant ($p < 0.006$) pre–post improvements were observed for resilience (BRS, b = 0.2, $p = 0.00$, 95% CI = 0.1, 0.2) and insomnia (ISI, b = −1.5, $p = 0.00$, 95% CI = −2.1, −0.9).

However, changes in quality of work-life (ProQoL-9) were not statistically significant ($p < 0.006$): compassion fatigue (b = −0.3, $p = 0.05$, 95% CI = −0.5, −0.003), burnout (b = −0.4, $p = 0.007$, 95% CI = −0.7, −0.1), and compassion satisfaction (b = 0.1, $p = 0.41$, 95% CI = −0.1, 0.4).

Standardized results

In the main effects model including standardized scores (Table 4), PSS-10 scores fell by 0.5 standard deviations (SD) compared to 0.3 SD or less for other outcomes.

Intervention group

We identified no statistically significant main effects of the intervention group on any outcomes (Supplemental Material S1). However, significant time-by-group interactions before *p*-value adjustment ($p < 0.05$) were observed for insomnia (ISI, b = −1.3, $p = 0.04$, 95% CI = −2.5, −0.03) and burnout (ProQoL-BO, b = −0.7, $p = 0.01$,

TABLE 4 Mixed-effects linear regression (adjusted findings), pre–post changes in z-scores of the outcome variable.

Mental health, health, and quality of work-life outcomes (Z-Scores) b(95% CI)									
	PSS-10	**PHQ-4 Distress**	**PHQ-4 Anxiety**	**PHQ-4 Depression**	**BRS**	**ISI**	**ProQoL-CF**	**ProQoL-CS**	**ProQoL-BO**
Time point									
Post-intervention (ref = pre)	−0.5*,** (−0.6, −0.4)	−0.3*,** (−0.5, −0.2)	−0.3*,** (−0.5, −0.2)	−0.3*,** (−0.4, −0.2)	0.2*,** (0.1, 0.4)	−0.3*,** (−0.4. -0.2	−0.1* (−0.2, −0.001)	0.05 (−0.1, 0.2)	−0.2* (−0.3, −0.04)
Group									
Basic (ref = comp)	0.01 (−0.2, 0.2)	0.1 (−0.1, 0.3)	0.04 (−0.2, 0.3)	0.2 (−0.1, 0.4)	0.1 (−0.2, 0.3)	0.1 (−0.2, 0.3)	−0.2 (−0.4, 0.1)	−0.1 (−0.3, 0.2)	0.01 (−0.2, 0.3)

Note: This regression model includes standardized outcome variables (Z-scores) to allow for the cross comparison of the various outcomes. The regression model adjusted for covariates including intervention group, age, sex, English as a first language, culture/race, role, hours of housework a day, shift worked most of the time, length worked in role (years), hours worked in 2 weeks, coping skills and activities (multiactivity variable), and habits (multihabit variable as sum of number of habits).

Abbreviations: BRS, brief resilience scale; Comp, comprehensive intervention group; ISI, insomnia severity index; PHQ-4, patient health questionnaire for anxiety and depression; ProQoL-BO, professional quality of life-burnout subscale; ProQoL-CF, professional quality of life-compassion fatigue subscale; ProQoL-CS, professional quality of life-compassion satisfaction subscale; PSS-10, perceived stress scale; Ref, reference variable in regression model.

*Statistically significant at 0.05 without *p*-value correction.

**Statistically significant at 0.006–Bonferroni's *p*-value correction for 9 outcome variables.

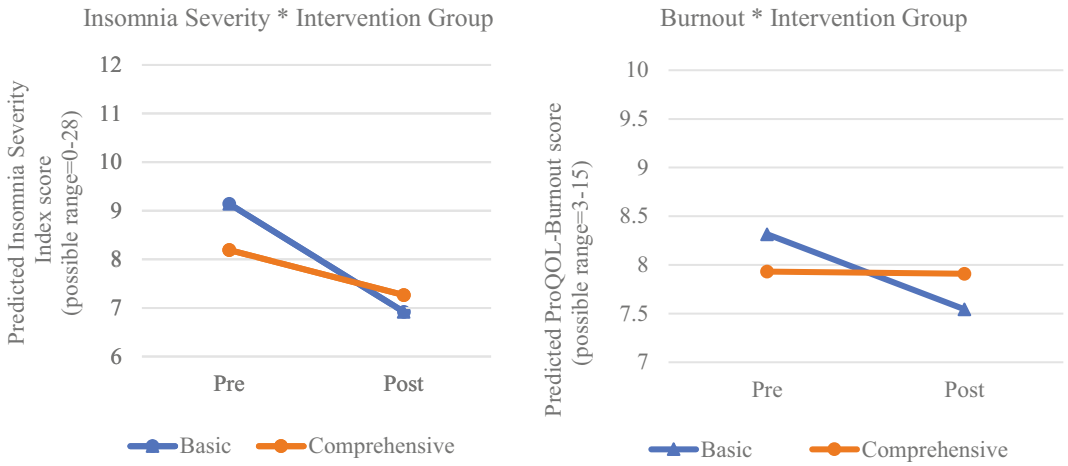

FIGURE 1 Statistically significant time by intervention group interactions ($p < 0.05$). The results of the mixed-effects linear regression analysis that regressed each outcome on time, group, and time-by-group interaction controlling for the covariates listed in the final results table in the supplemental materials. This figure reports the two outcomes found to be significant in this regression analysis at $p < 0.05$. The abbreviation ProQoL represents the Professional Quality of Life Scale; in this case, the figure particularly reports on the burnout subscale.

95% CI = −1.3, −0.2). These outcomes improved more from pre-to-post-intervention in the basic group compared to the comprehensive group. See Figure 1 for the statistical interactions for these statistically significant variables and Supplemental Material S5 for the time-by-group interaction results.

Adherence sensitivity analysis

In the sensitivity analysis including adherence scores from the 75% of participants (192/254) who completed the breathing diaries, there were no statistically significant results after *p*-value adjustment for the main effects of adherence group or the interaction of the time-by-adherence (Supplemental Material S6 and S7). We did not include the adherence variable in our primary model, as we only have the data for 75% of the participants.

DISCUSSION

Various breathing methods, including coherent breathing, are commonly used in many fields, such as psychiatry and psychology; however, to our knowledge, no studies have looked at the influence of this technique on LTC staff.[10] Our findings are positive and encouraging, albeit observational and from a non-representative sample with no control group to compare outcomes. Our study included a diverse sample of largely racialized immigrant women who speak English as a second language, consistent with the demographics of the care aide population in Canada.[1,2,9] This study is the first of which we are aware to identify positive associations between coherent breathing and mental health and quality of work-life outcomes for LTC staff.

Our findings suggest that coherent breathing may be a useful strategy to improve stress, mental health, physical health, and quality of work-life outcomes in LTC staff. These findings are, therefore, important as they are the first of which we are aware to demonstrate such improvements. These improvements are particularly important for staff in LTC homes where quality of work-life has been long neglected. These homes have long struggled with care quality issues and providing a high quality of life and end-of-life to their residents, who are largely vulnerable older adults in the last stages of life. Improving stress management is thus essential to LTC staff for their well-being, and the residents who depend so heavily on them to meet their complex needs.[1–5,9]

The standardized results of our study (Table 4) suggest that the intervention may have had a stronger effect on general stress (PSS-10) compared to other outcomes. Therefore, general self-perceived stress, such as that measured with PSS-10, may be an important outcome in future studies focused on similar interventions. The clinical significance of these results in our study population requires further investigation.

Our findings align with the findings of studies in other populations that have included healthy adults and individuals with anxiety or depression. Using similar breathing interventions, these studies have observed reductions in stress and improvement in mental and physical health outcomes, including anxiety and sleep.[10,11,13–16] Our findings are also similar to studies focused on healthcare professionals in hospital and

community settings during COVID-19 in India and China. These studies reported improvements in mental and physical health, insomnia and resilience outcomes using diaphragmatic and Yogic breathing and different lengths of breathing sessions.[15,16] None of these studies focused on LTC staff.

In contrast to most literature focused on biofeedback,[9] which reports its usefulness as an adjunct in similar interventions, our findings did not demonstrate any advantage to using the biofeedback device. This is similar to Schlatter et al.'s[38] randomized pilot study addressing medical residents' stress and relaxation, where no difference was found between relaxed breathing only and relaxed breathing plus biofeedback groups.[38] It may be useful to explore reasons for this lack of difference in future studies. In our case, the participants' difficulties with the biofeedback device may have been a factor, including difficulties signing into the app, connecting their sensor to their phone, or not having their sensor available when they wanted to complete breathing.

Limitations

This study has some important limitations—it was a pre-post-intervention study with no control group, and the changes observed may not be entirely due to the intervention. Testing effects are a main concern in a pre–post study as participants completed the same questionnaire pre- and post-intervention (i.e., more positive results on post-test are not uncommon). Events occurring at the same time as the intervention, such as changes to COVID restrictions and other potential historical threats, are less likely to have influenced our results due to the relatively brief duration of our study (8 weeks). Our high attrition rate and loss of participants may have biased our results, although, for the 254 remaining participants, the improvements in mental and physical health scales are promising. Last, as we used convenience sampling, sample representativeness and generalizability are limited.[39] Findings should be interpreted with these limitations in mind.

CONCLUSION

This study addressed calls for practical and accessible interventions to improve stress, mental health, and quality of work-life outcomes for staff working in LTC homes during COVID-19.[4,8] This simple coherent breathing intervention was associated with improved scores on mental and physical health scales, including improvements in stress, anxiety, depression, psychological distress, resilience, and insomnia among LTC staff in Alberta. Coherent breathing may be a useful and simple strategy for assisting LTC staff with stress management and is worth further evaluation using a more robust design. By helping to improve LTC staff's stress and well-being, this strategy has the potential to positively influence resident quality of care and quality of life.

AUTHOR CONTRIBUTIONS

B. DeGraves, H. Titley, T. Thorne, J. Keefe, S. Banerjee, L. Ginsburg, J. Salma, K. Hegadoren, R. Lanius, and C.A. Estabrooks helped to develop the study concept and design. B. DeGraves, H. Titley, and T. Thorne were involved in collecting data and recruiting participants. B. DeGraves, Y. Duan, and H. Titley analyzed the data for this manuscript. B. DeGraves, Y. Duan, H. Titley, C. Angel, T. Thorne, and C.A. Estabrooks wrote and revised the manuscript. C.A. Estabrooks obtained funding. All authors contributed to the interpretation of results and the revision of the article.

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CONFLICT OF INTEREST STATEMENT

There are no relevant conflicts of interest to report. C. Angel and B.DeGraves work for Alberta Health Services (AHS) in departments not associated with AHS research funding. T.Thorne reports working inside the continuing care portfolio of AHS (Edmonton Zone) but outside provincial funding levels. S.Banerjee reports personal fees and non-financial support from Lilly, personal fees from Boehringer-Ingelheim, personal fees from Axovant, personal fees from Lundbeck, personal fees from Nutricia and honoraria from the Hamad Medical Service for lectures and talks, all outside the submitted work; he is a Trustee of the Alzheimer's Society and has research grants from NIHR, ESRC, CIHR, Alzheimer's Society, the Alzheimer's Association and ESPRC.

SPONSOR'S ROLE

The sponsor had no role in the manuscript's design, recruitment, methods, analysis, or preparation.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Supplemental Material S1. Mixed-effects regression (Adjusted findings including covariates). Pre–post changes in outcome scores. Explanation: This table reports on the main mixed-effects regression model's findings, including all covariates used in the mixed-effects regression model to determine the pre–post changes in mental health outcomes.

Supplemental Material S2. Demographics and reported mental health scores of participants who did not complete the study compared to those who completed (Time 1). Explanation: This table reports the demographics and mean reported mental health scores of the 254 participants who completed the intervention (the main sample) compared to the 129 individuals who only completed the pre-measures (at time 1).

Supplemental Material S3. Repeated measures ANOVA. Pre–post changes in Knowledge Test scores. Explanation: Repeated measures ANOVA run separately per each role, to identify the pre–post changes in knowledge test scores between the three time points: pre (pre-education session), post (directly post-education session), and follow-up (after the 8-weeks of coherent breathing).

Supplemental Material S4. Pairwise comparisons, repeated measures ANOVA. Pre–post changes in Knowledge Test scores per role. Explanation: Repeated measures ANOVA were run separately per each role to identify the pre–post changes in knowledge test scores per role. The knowledge test was administered at three times points, pre (pre-education session), post (directly post-education session), and follow-up (after the 8-weeks of coherent breathing). The pairwise comparison mean difference is the mean difference between the pre- and post-questionnaires in overall knowledge test scores.

Supplemental Material S5. Mixed-effects regression model (Adjusted findings including covariates). Time by intervention group interactions in outcome scores. Explanation: The results of the mixed-effects linear regression analysis including the regression findings of the time-by-group (intervention group) interaction while controlling for covariates.

Supplemental Material S6. Mixed-effects regression model (Adjusted findings including covariates). Time by adherence score interactions in outcome scores. Explanation: The results of the mixed-effects linear regression analysis including the regression findings of the time-by-adherence score (the level of participation the participant had compared to the recommended number of breathing sessions per week) interaction while controlling for covariates.

Supplemental Material S7. Pairwise comparison: Estimated mean difference (post-intervention mean minus pre-intervention mean) derived from the mixed-effects regression model including time-by-adherence interaction (adjusted including covariates). Explanation: The difference in pre–post estimated marginal means derived from the mixed-effects linear regression model including time-by-adherence interaction. This table reports the difference (post-intervention minus pre-intervention) in means for each mental health outcome based on level adherence, and reports whether these differences in means from pre to post were significant.

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Editor's Note

My career in geriatric nursing began at age 15 when I took a job as a nursing assistant in a local, family owned and operated long-term care (LTC) facility. I primarily worked weekends on either evening or night shifts where in addition to assisting with, or providing complete personal care for the residents, we were also tasked with doing all the facility laundry in our spare time (I can still fold sheets like a pro☺). These experiences cemented my drive to pursue nursing and I'm forever grateful for a long and very satisfying career; however, I do remember many times when at the end of a long shift, I was physically and/or emotionally drained.

The simple, yet elegant, intervention tested and described in this article resonated with me as soon as it crossed my desk. The authors acknowledge several methodologic limitations that should be addressed in the future studies. Despite these limitations, findings suggesting that a low-cost, coherent breathing intervention improves scores on mental and physical health, is exciting and something that administrators and clinicians can, and should, support. Although caring for some of the most vulnerable persons in a society can be rewarding and even life- and career-changing, we also know from work our colleagues are doing that fundamental and serious challenges exist in the United States LTC health system (2022 NASEM Quality of Nursing Home Report: Moving Recommendations to Action – Travers – 2023 – Journal of the American Geriatrics Society – Wiley Online Library). The potential for LTC staff to use this type of stress-reduction strategy with, or without access to biofeedback, is an important step in the right direction. I applaud the authors for continuing this journey to improve the health and well-being of those who do this critical work; If I'd had access to coherent breathing in the 1970's, believe me I would have used it!.

-***Christine Bradway, PhD, GNP-C, FAAN, AGSF***