

Daily self-regulation with biofeedback to improve stress and job satisfaction in a primary care clinic

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ABSTRACT

Background: Burnout in healthcare professions is higher than other careers. An undesirable work-life balance has resulted in declining job satisfaction among primary care physicians. Biofeedback devices teach self-regulation techniques, which reduce stress and increase resilience. **Objectives:** We assessed whether self-regulation with biofeedback is effective at decreasing stress and improving job satisfaction among primary care clinicians and nurses. **Methods:** Two naturally occurring cohorts of clinicians and nurses were followed over 12 weeks. The treatment group (N = 9) completed 12 weeks of self-regulation with optional clinic-based biofeedback and received peer support for the first half. The control group (N = 9) started a delayed intervention after 6 weeks without peer support. Descriptive and bivariate analyses were conducted. **Results:** The treatment group averaged one biofeedback session weekly for 6 min and the control group two sessions for 11 min. Adherence differed by age. Subjects also reported using self-regulation techniques without biofeedback. Perceived stress initially increased in both groups with intervention implementation, more so in the treatment group ($P = 0.03$) whose stress then decreased but was not significant. Overall and extrinsic job satisfaction similarly increased but were not significant. **Conclusion:** The initial increase in perceived stress was related to daily biofeedback adherence and clinic responsibilities. Treatment group stress then decreased with self-regulation but was difficult to quantify in a small cohort. Larger studies could increase daily self-regulation adherence by improving biofeedback accessibility for leisurely use. Using self-regulation with biofeedback may be an innovative approach to reduce stress and improve job satisfaction in primary care.

Keywords: Biofeedback, burnout, family medicine, heart rate variability, job satisfaction, primary care, resilience, self-regulation, stress reduction

Introduction

Primary care medicine is an extraordinarily stressful career. Over 60% of U.S. family physicians report at least one burnout symptom and only 35% are satisfied with their work-life balance.^[1]

Mental and emotional homeostasis can be restored by cultivating “psychophysiological coherence” defined as the specific physiological state (i.e., cardiac coherence) associated with optimum cognitive functioning, emotional stability, and social resilience.^[2-5] Cardiac coherence is represented by a sine-wave-like heart rate variability (HRV) pattern at a frequency close to 0.1 Hz.^[6] Practicing emotional self-regulation with a validated biofeedback tool can teach physicians how to deliberately achieve cardiac coherence using self-regulation without biofeedback.^[2,4,5]

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Methods

Physicians, nurse practitioners, and nurses were recruited for the 12-week, quasi-experimental study from two family medicine clinics. A coin toss was used to select the treatment clinic and the control clinic where the study participants already worked. All participants attended a baseline 1-h training session where they learned the quick-coherence self-regulation technique and practiced using the emWave Pro biofeedback device, both of which were developed by the HeartMath Institute, Boulder Creek, California. The quick coherence technique starts with heart-focused, rhythmic breathing followed by a self-initiated re-experiencing or remembering of positive emotion or appreciation for a person, place, or thing.

The treatment group was asked to perform 5 min of daily self-regulation with optional biofeedback over 12 weeks, the first 6 of which included weekly peer support. There were two desktop-based biofeedback devices set up at each clinic. If biofeedback could not be used, participants were encouraged to just use the heart-focused breathing or quick coherence technique alone. During the baseline training session, participants were educated when to use quick coherence, such as before stress (before going to or starting work, before a meeting or important call), immediately after stress (on way home from work, before sleep), or in the moment when challenging events occurred. The control group started the intervention at week 7 without peer support. Peer support was used in the treatment group for the first 6 weeks to observe if it would make a difference in both adherence and achieving cardiac coherence. In the second 6 weeks, both groups did the intervention without support to observe the intervention pragmatically.

Demographics were collected along with years in present job and current field. Stress and job satisfaction were measured at baseline, week 7, and post-intervention using the Perceived Stress Scale (PSS) and the Minnesota Satisfaction Questionnaire—Short Form (MSQ-SF), respectively.^[6,7] Weekly logs tracked daily minutes of biofeedback (zero if incomplete) and daily cardiac coherence achievement score (numerical score based on a proprietary algorithm where higher values indicate higher coherence).^[8] At the end of the study, participants completed a quantitative survey on their experience with self-regulation and its sustainability.

Descriptive and bivariate analyses were completed for each group. Significance was judged at <0.05 using P values from Wilcoxon rank sum and signed rank tests. Our Institutional Review Board (IRB) approved this research study before its commencement (IRB#: 2016-0-0018).

Results

The control clinic enrolled 7 physicians and 2 ARNPs (60.0% clinic participation rate) with one physician exiting. The treatment clinic enrolled 4 physicians and 5 nurses with one physician and

nurse exiting (90.0% clinic participation rate). Of the three exiting participants, two were for reasons unrelated to the study, while the treatment group physician exited after deciding she did not have enough time for daily self-regulation. T1 and T2 defined the treatment group for the first and second 6 weeks respectively, while C1 and C2 defined the control group.

Each week, the treatment group averaged one completed biofeedback session for 6 total minutes, while the control group averaged nearly two completed sessions for 11 total minutes. Despite using biofeedback less often than the control group, average achievement score was higher in the treatment group (T1/2 Mean (SD): 49.2 (43.7), C1/2 Mean (SD): 33.8 (79.5)). Stratification by age indicated that older treatment group participants (≥ 44 years old) increased biofeedback use by nearly 3 min per session over the course of the study [Table 1].

Although we did not formally measure the use of self-regulation without biofeedback, study participants in both groups indicated that they did use the quick coherence technique without biofeedback. Furthermore, most control group participants indicated infrequent skipping of daily self-regulation. As expected, both groups indicated there were not enough hours in their day, they frequently felt overwhelmed, did not have time for a full lunch break or self-regulation, and did not frequently feel ahead on their daily tasks [Table 2].

After 6 weeks of the intervention, perceived stress increased in both groups, more so in the treatment group (PSS; T1: 0.50, C2: -0.06; $P = 0.03$). While the decrease in perceived stress in the second 6 weeks was not significant in the treatment group, there was an increase in both overall and extrinsic job satisfaction that approached significance (MSQ; T1: -0.14, T2: 0.25; $P = 0.06$ and MSQ_Ext; T1: -0.08, T2: 0.20; $P = 0.07$) [Table 3].

Discussion

The term “stress” was coined in 1936 by the pioneering, Hungarian-Canadian endocrinologist Hans Selye. Selye defined stress as “the non-specific response of the body to any demand for change.”^[9] Productivity initially increases with increased stress (“eustress”); however, after a certain point for each individual, eustress becomes distress when fatigue, exhaustion, and health decline follow.

Burnout results from increasing interpersonal work stress without a concomitant increase in stress adaptation or resilience. Symptoms of burnout include fatigue, cynicism, job detachment, and job dissatisfaction. Physician burnout is significantly higher than most other careers, with an undesirable work-life balance resulting in a significant decline in job satisfaction over recent years, particularly among primary care physicians.^[10,11] More than a third of primary care nurses also experience burnout.^[12]

A validated biofeedback tool has been previously used to teach practitioners emotional self-regulation techniques

Table 1: Participant Demographic Characteristics (n=18)

	Treatment Group (n=9)		Control Group (n=9)	
Age (in years), Mean (SD)	44.0 (7.7)		40.0 (9.8)	
Gender, n (%)				
Female	7 (78.0)		7 (78.0)	
Male	2 (22.0)		2 (22.0)	
Race, n (%)				
Caucasian	7 (78.0)		8 (89.0)	
Black/African American	2 (22.0)		0 (0.0)	
Other	0 (0.0)		1 (11.0)	
Years at current job, Mean (SD)	5.5 (7.6)		8.2 (6.6)	
Years in field, Mean (SD)	12.2 (9.8)		12.3 (8.0)	
# of weekly sessions, Mean (SD)				
All: 1 st 6 weeks (T1)/2 nd 6 weeks (T2)	1.1 (3.0)	1.3 (3.9)	-----	-----
All: 1 st 6 weeks (C1)/2 nd 6 weeks (C2)	-----	-----	-----	1.9 (3.9)
# of weekly sessions (≥44 years old), Mean (SD)				
1 st 6 weeks (T1)/2 nd 6 weeks (T2)	0.9 (1.0)	1.0 (4.0)	-----	-----
1 st 6 weeks (C1)/2 nd 6 weeks (C2)**	-----	-----	-----	2.3 (4.0)
# of weekly sessions (≥44 years old), Mean (SD)				
1 st 6 weeks (T1)/2 nd 6 weeks (T2)	1.5 (2.9)	2.0 (4.0)	-----	-----
1 st 6 weeks (C1)/2 nd 6 weeks (C2)	-----	-----	-----	1.6 (3.9)
Minutes per week, Mean (SD)				
All: 1 st 6 weeks (T1)/2 nd 6 weeks (T2)	6.4 (1.0)	6.7 (2.0)	-----	-----
All: 1 st 6 weeks (C1)/2 nd 6 weeks (C2)**	-----	-----	-----	11.3 (1.5)
Minutes per week (<44 years old), Mean (SD)				
1 st 6 weeks (T1)/2 nd 6 weeks (T2)	5.8 (0.9)	4.8 (1.9)	-----	-----
1 st 6 weeks (C1)/2 nd 6 weeks (C2)**	-----	-----	-----	11.5 (1.4)
Minutes per week (≥44 years old), Mean (SD)				
1 st 6 weeks (T1)/2 nd 6 weeks (T2)*	7.8 (0.9)	10.3 (1.5)	-----	-----
1 st 6 weeks (C1)/2 nd 6 weeks (C2)**	-----	-----	-----	11.3 (1.5)
Cardiac Coherence Achievement Score, Mean (SD)	49.2 (43.7)		33.8 (79.5)	

*P<0.10, **P<0.05. P were calculated using rank sum/sign tests. T1: 1st 6 weeks of treatment group, T2: 2nd 6 weeks of treatment group, C1: 1st 6 weeks of control group, C2: 2nd 6 weeks of control group

providing immediate and sustained psychological benefits.^[2,4] The biofeedback process connects the practitioner to an HRV monitor while they practice specific self-regulation techniques to help achieve cardiac coherence. Although adding biofeedback to stress management interventions can improve indicators of stress, there are limited physician studies using self-regulation techniques with biofeedback to reduce stress, none of which are in primary care settings.^[13] One randomized controlled trial (RCT) has shown self-regulation techniques with biofeedback monitoring are a simple, effective stress-reduction strategy for tertiary care physicians.^[14] Another healthcare study used a pretest/posttest model and self-selected employees (including physicians and nurses) within an academic medical center; their results supported the stress-reducing and resilience-building effects of self-regulation with biofeedback.^[15] Even though some studies have not observed any significant effectiveness of biofeedback,^[13] studies looking at other high-stress professions had more promising and consistent results. For example, a study of combat veterans both with and without PTSD showed cognitive improvement after training in self-regulation and weekly HRV,^[5] and an RCT demonstrated that pre-deployment self-regulation training resulted in lower post-deployment PTSD symptom scores.^[16] A study with correction officers revealed significant improvements in resilience, cholesterol, glucose, heart rate, and blood pressure

at a projected annual healthcare cost savings of \$1,179 per employee.^[17] Chronic diseases often have a psychological component, and numerous studies have also demonstrated reduced stress and improved psychological functioning in these patients when using self-regulation with HRV biofeedback^[18-23] and without it.^[24] Thus, there is a need to assess whether using a daily self-regulation practice with HRV biofeedback is a practical way to improve stress and job satisfaction amongst primary care clinicians and nurses.

Studies have shown self-regulation and resilience to be positive predictors of physician well-being and negative predictors of burnout.^[10,25-28] Our study reaffirms these findings in clinicians and nurses. Had the intervention continued over a longer period of time, we would expect continued improvements in average achievement scores, perceived stress, and job satisfaction.

The treatment group completed less weekly biofeedback sessions with less time per session compared to the control group, suggesting that weekly peer support did not help improve adherence. However, average achievement score was higher in the treatment group, a possible result of the initial weekly peer support encouraging cardiac coherence and doing the intervention 6 weeks longer than the control group. On the other hand, the control clinic may have had a work flow that allowed

Table 2: Attitudes towards and experiences with self-regulation (n=14)

			Never or Almost Never n (%)	Sometimes, n (%)	Fairly or Very Often, n (%)
Self-Regulation	Frequency of self-regulation use	Treatment	2 (28.6)	3 (42.9)	2 (28.6)
		Control	2 (28.6)	3 (42.9)	2 (28.6)
		Total	4 (28.6)	6 (42.9)	4 (28.6)
	Frequency of self-regulation use for stress relief	Treatment	2 (28.6)	3 (42.9)	2 (28.6)
		Control	3 (42.9)	4 (57.2)	0 (0.0)
		Total	5 (35.7)	7 (50.0)	2 (14.3)
	Frequency of skipping self-regulation	Treatment	2 (28.6)	3 (42.9)	2 (28.6)
		Control	3 (42.9)	4 (57.2)	0 (0.0)
		Total	5 (35.7)	7 (50.0)	2 (14.3)
Time in Clinic/for Self-Regulation	Not enough hours in day	Treatment	0 (0.0)	1 (14.3)	6 (85.7)
		Control	0 (0.0)	1 (14.3)	6 (85.7)
		Total	0 (0.0)	2 (14.3)	12 (85.7)
	Overwhelmed feeling	Treatment	0 (0.0)	4 (57.2)	3 (42.9)
		Control	1 (14.3)	1 (14.3)	5 (71.4)
		Total	1 (7.2)	5 (35.7)	8 (57.1)
	Time allowed for self-regulation	Treatment	6 (85.7)	1 (14.3)	0 (0.0)
		Control	5 (71.4)	1 (14.3)	1 (14.3)
		Total	11 (78.6)	2 (14.3)	1 (7.2)
	Felt ahead in daily tasks	Treatment	3 (42.9)	4 (57.2)	0 (0.0)
		Control	5 (71.4)	2 (28.6)	0 (0.0)
		Total	8 (57.1)	6 (42.9)	0 (0.0)
	Had time for full lunch break	Treatment	3 (42.9)	0 (0.0)	4 (57.2)
		Control	4 (57.1)	2 (28.6)	1 (14.3)
		Total	7 (50.0)	2 (14.3)	5 (35.7)
	Feel patients received appropriate time	Treatment	0 (0.0)	1 (14.3)	6 (85.7)
		Control	2 (28.6)	1 (14.3)	4 (57.2)
		Total	2 (14.3)	2 (14.3)	10 (71.4)

Table 3: Comparing differences between stages, within, or across arms (n=18)

		Mean value of Δ				P				
		Treatment (T)		Control (C)		T	C	T vs. C		
		T1	T2	C1	C2	T1 vs T2	C1 vs C2	T1 vs C1	T2 vs C2	T1 & C2
Change (Δ) between periods-All	MSQ*	-0.14	0.25	0.14	0.20	0.06	1.0	0.13	1.0	0.61
	MSQ_Ext ^r **	-0.08	0.20	0.08	0.15	0.07	0.83	0.13	1.0	0.80
	MSQ_Intr ^r **	-0.19	0.31	0.18	0.26	0.16	0.84	0.05	0.94	0.64
	PSS****	0.50	-0.08	-0.06	0.17	0.16	0.79	0.07	0.41	0.03
Change (Δ) between periods-<44 years old	MSQ*	-0.11	0.49	0.26	0.15	0.25	0.63	0.23	0.21	0.59
	MSQ_Ext ^r **	-0.01	0.41	0.23	0.15	0.50	0.71	0.28	0.37	0.40
	MSQ_Intr ^r **	-0.22	0.59	0.29	0.16	0.25	0.88	0.11	0.23	0.93
	PSS****	0.23	0.13	-0.15	0.2	1.0	0.79	0.63	1.0	0.29
Change (Δ) between periods-≥44 years old	MSQ*	-0.17	0.02	-0.03	0.30	0.50	1.0	0.70	0.14	0.81
	MSQ_Ext ^r **	-0.16	-0.01	-0.10	0.15	0.25	1.0	0.70	0.55	0.86
	MSQ_Intr ^r **	-0.16	0.03	0.04	0.45	0.75	0.5	0.51	0.20	0.68
	PSS****	0.77	-0.30	0.07	0.10	0.25	1.0	0.08	0.40	0.10

T1: the mean of the 1st 6 weeks' changes in treatment group. (Mean (week 6-Baseline)). T2: Mean of 2nd 6 weeks' changes in treatment group. (Mean (week 12-week 6)). C1: Mean of 1st 6 weeks' changes in control group. (Mean (week 6-Baseline)). C2: Mean of 2nd 6 weeks' changes in control group. (Mean (week 12-week 6)). T1&C2: Mean of pooled changes in 1st 6 weeks in treatment group & 2nd 6 weeks in control group. *As MSQ score increases, job satisfaction increases. Therefore, a higher or positive change (Δ) MSQ score is the expected result from this intervention. **As MSQ_Ext^r score increases, extrinsic job satisfaction increases. Therefore, a higher or positive change (Δ) MSQ_Ext^r score is the expected result from this intervention. ***As MSQ_Intr^r score increases, intrinsic job satisfaction increases. Therefore, a higher or positive change (Δ) MSQ_Intr^r score is the expected result from this intervention. ****As PSS score increases, stress increases. Therefore, a lower or negative change (Δ) in PSS score is the expected result from this intervention

more time for self-regulation sessions or had subjects with a more favorable view of self-regulation practices.

Perceived stress was higher and job satisfaction lower in the first 6-week period followed by a trending increase in job satisfaction and decrease in perceived stress. It is well known

that self-regulation increases self-awareness, so the initial increase in perceived stress is not surprising if using the biofeedback device daily while at work was first experienced as an additional clinic responsibility. Once subjects experienced some of the beneficial effects of self-regulation, it may have become more desirable for them to continue it as a daily or

regular practice, especially in the treatment group which was older than the control group.

Age may be a contributing factor to new interventions implemented in the clinical environment. Interestingly, once those ≥ 44 years of age adopted self-regulation practices, they participated in more sessions over longer periods of time. Additionally, the increase in both average number of weekly sessions and session length in all age groups indicates positive receipt of the short 12-week intervention. Future studies may focus on why age impacts adoption of self-regulation. Moreover, studies evaluating the connection between provider behavior, self-regulation practices, and biofeedback use would provide useful insights.

The implications of this self-regulation intervention show promise for clinicians of all ages working in high stress environments with the potential for lower job satisfaction. Current large-scale studies on primary care burnout show a high prevalence rate between 40 and 55% among clinicians and staff.^[10,29-31] Resilience sits on the opposite end of the spectrum from interpersonal stressors, such as work-life balance, and is said to combat burnout.^[32-34] This study demonstrates that self-regulation practices for primary care physicians can help them adapt to interpersonal stressors resulting in building their personal resilience to prevent or reverse burnout.

The limitations of this pilot study are biofeedback non-adherence, a short intervention period, and pooled results. For example, despite being able to use self-regulation at any time *without* biofeedback, one physician exited the treatment group because it was difficult to add 5 min of daily biofeedback to numerous other clinic responsibilities. However, this physician felt that biofeedback was helpful to initially learn the self-regulation techniques, which she still uses “throughout the day to de-stress and before sleep.”

Since self-regulation is the intervention and biofeedback supportive, a larger study can improve adherence by providing participants their own phone-based biofeedback device to use at any time.^[13] If the number of such biofeedback devices were limited, participants could share devices to achieve a recommended minimum weekly use (previously reported as min/week).^[13] Furthermore, the frequency of self-regulation without biofeedback should be analyzed (we only collected biofeedback-based data because we initially thought achievement score would be most objective). If adherence were improved, the intervention period would not necessarily need to be longer.^[13] Rather than pooling results, a larger sample size would also allow stress and job satisfaction levels to be separately assessed based on clinical role such as physician, advanced practice clinician, nurse, etc. Despite the limitations of this pilot, these insights are invaluable for future studies looking to improve physician well-being.

In conclusion, the initial increase in perceived stress was related to daily biofeedback adherence along with clinic responsibilities.

Treatment group stress then decreased with self-regulation but was difficult to quantify in a small cohort. Future studies should include more participants and could increase self-regulation adherence by supplying portable biofeedback devices to allow leisurely use. Using biofeedback to train primary care clinicians and nurses in self-regulation may be an innovative approach to reduce stress and improve job satisfaction.

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Conflicts of interest

There are no conflicts of interest.

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