

Anxiety, anger, salivary cortisol and cardiac autonomic activity in palliative care professionals with and without mind-body training experience: results from a pilot study

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Abstract

Introduction: Palliative care practitioners suffer a considerable burden of stress.

Although it is not possible to eliminate stress entirely, people can learn to manage it. Mind/Body intervention help individuals turn maladaptive responses to stress into more adaptive ones. The aim of the study was to assess the impact of mind

body techniques in a group of Palliative Care professionals. **Methods:** We investigated anxiety, anger, baseline salivary cortisol levels immediately after awakening and autonomic nervous system activity in a group of health care professionals from a Palliative Care Unit (n = 22). In addition, we assessed the autonomic response to relax instructions. The participants were divided into two groups according to their regular practice of mind-body techniques. **Results:** No significant differences between groups were found for anxiety and anger. Baseline salivary cortisol levels were significantly greater in the untrained group (5.23 ± 5.16 $\mu\text{g/dl}$) when compared with the trained one (0.57 ± 0.19 $\mu\text{g/dl}$) (Mann-Whitney U Test = 0; $p < 0.001$). When comparing heart rate variability (HRV) values during relaxation with HRV values at rest within each group, trained subjects showed a significant increase in LF% ($z = -2.073$, $p = 0.038$), while untrained subjects showed a significant increase in HF% ($z = -2.100$, $p = 0.036$). **Conclusions:** Subjects who regularly practice mind-body techniques evidenced lower baseline morning cortisol levels and achieved a differential autonomic response to relax instructions.

Keywords: health promotion; mind/body; palliative care

Introduction

The aim of palliative care is to relieve suffering and provide the best possible quality of life for people who face pain, unpleasant symptoms, the stress of having a serious illness and who are usually approaching the end of their life. Palliative care practitioners suffer a considerable burden of stress such as constant exposure to death, insufficient time, communication difficulties with dying patients and relatives, and potentially inadequate coping with their own emotional response [1]. Health workers may also experience emotions such as feelings of depression, grief, anxiety, anger and guilt while providing care to patients [2]. Anxiety, anger and depression are important indicators of psychological distress, and symptoms of high anxiety are typically found in almost all emotional disorders [3-4].

Although it is not possible to eliminate stress entirely, people can learn to manage it [3-5]. The National Institute of Health defines Mind-Body Techniques as “interventions that use a variety of techniques designed to facilitate the mind's capacity to affect bodily function and symptoms” [6]. These interventions include practices such as relaxation techniques, meditation, guided imagery and yoga; where body movements (asana), breathing exercises (pranayama) and meditation are integrated into a single multidimensional practice. In general, they help individuals turn maladaptive responses to stress into more adaptive ones [7]. Among primary care physicians, participation in a mindful communication program has been associated with sustained improvements in well-being and attitudes associated with patient-centered care [8].

Stress levels may be assessed in a variety of ways. In experimental studies [4-6] the effectiveness of stress management interventions in workplace settings has been determined using variables derived from psychological tests (e.g., stress, anxiety, or depression tests) and, to a lesser extent, using physiological measurements (e.g., blood pressure, heart rate, salivary cortisol, galvanic skin response). Psychological factors are known to affect the cortisol awakening response (CAR) and there is consistent evidence that the Hypothalamus-Pituitary-Adrenal (HPA) axis mediates the stress response [9]. The CAR is defined as the change in free cortisol from waking up to 30-90 minutes afterwards. The normal stress response curve demonstrates a steep rise in free cortisol levels, rising by 50–160% within the first 30 minutes after awakening, remaining elevated for at least 60 minutes, and after peaking, returning to basal levels within 1-2 hours [10]. An enhanced CAR is associated to job stress and general life stress, while a reduced CAR is related to fatigue, burnout, exhaustion or post-traumatic stress syndrome [11].

In addition, chronic and short-term stress have effects on the autonomic control of the heart [12]. The autonomic imbalance that occurs when the sympathetic activity dominates over the parasympathetic activity for long periods is associated with pathological conditions and cardiovascular risk [13]. Given that the relatively constant heart rate generated by the sino-atrial node is modulated by parasympathetic and sympathetic influences, measures of heart rate variability (HRV) can be used to assess autonomic nervous system activity [14].

Data on changes in stress levels, from programs designed to reduce stress or burnout, or the strategies to promote well-being in palliative care professionals are scarce. Nevertheless, it is widely acknowledged that it is a stressful clinical practice environment [15-16]. To assess the impact of mind body techniques in a group of Palliative Care professionals, this pilot study compared anxiety, anger, baseline salivary cortisol levels and autonomic nervous system activity in subjects who had previously received training in mind-body techniques and who had practiced these techniques for at least a year with those who had not received such training. In addition, the autonomic response to relaxation instructions was assessed for both groups. The hypothesis was that professionals trained in and practicing mind body techniques have lower levels of anxiety, anger and baseline salivary cortisol, as well as a higher parasympathetic basal tone. In addition, we hypothesized that the 'trained' group would show a differential autonomic response to relaxation instructions.

Methods

Subjects

A total of 22 health care professionals from the Palliative Care Unit of *Hospital de Clínicas José de San Martín* (Buenos Aires, Argentina) were enrolled

in the present study. A recruiting e-mail explaining that participation was voluntary as well as, inclusion and exclusion criteria and time commitment required was sent to the professionals. The inclusion criteria were; being a health professional (physician, psychologist, nurse or social worker) and working in the Palliative Care Unit. The exclusion criteria were the refusal to sign the informed consent form or the presence of serious underlying medical or psychological conditions that could interfere with the results of the study (such as diabetes, Cushing's syndrome, depression or generalized anxiety disorder). Subjects were assigned to one of two groups, those who had been trained in a mind body technique (such as meditation, guided imagery or yoga) and who had at least one year of regular practice ('trained' professionals), and those who had no experience of a mind body technique ('untrained' professionals). The participants did not receive any kind of compensation for participating in the study and all gave written prior informed consent. The study was approved in advance by the local ethics committee.

Design

The participants were therefore divided into two groups according to their regular practice of mind-body techniques and for both groups psychological measurements and baseline salivary cortisol upon awakening were obtained. In addition, basal autonomic activity and autonomic response to relaxation instructions was assessed. A continuous electrocardiogram (ECG) signal was recorded while participants were sitting in a quiet room. Each recording session

was started by an initial resting period of two minutes. Then, individuals were asked to rest quietly for five minutes (rest), and instructed to close their eyes and relax themselves as best as they could for another five minutes (relaxation). No restrictions were imposed regarding the use of breathing exercises.

Measurements

Psychological Measures

The *State-Trait Anxiety Inventory* (STAI) [17-18] was used to evaluate state and trait anxiety. This test differentiates between transient state anxiety (STAI-S) and more stable trait anxiety (STAI-T). . Each subscale comprises 20 items. The range of scores for each subtest is 20–80, the higher score indicating greater anxiety

The State Trait Anger Inventory (STAXI, 1991) [19-20] was used to evaluate dispositional state and trait anger, as well as anger expression. It consists of five different scales, state anger (10 items), trait anger (10 items), anger-in (8 items), anger-out (8 items) and anger-control (8 items). State anger refers to the intensity of the individual's angry feelings at the time of testing. Trait anger measures the extent to which an individual is predisposed to experience anger or frustration in a range of situations. Individuals are asked to indicate on a four-point scale how often they generally react or behave in the manner described by each item. Anger

expression consists of three subscales. Anger-in measures the extent to which people hold things in or suppress anger when they are angry or furious. Anger-out measures the extent to which a person expresses her emotional experience of anger in an outwardly manner. Anger-control measures the expenditure of energy to control the physical or verbal expression of anger. A higher score on each of these scales represents a higher tendency to express the corresponding modality of anger. Range of scores for each subscale is: state anger (10-40), trait anger (10-40), anger-in (8-32), anger-out (8-32) and anger-control (8-32).

Salivary cortisol

All participants were instructed to take a single salivary sample immediately upon waking while they were still in bed, on any working day except Monday [21]. Saliva samples were collected by passive drooling into plastic tubes. Subjects were free to wake up according to their usual schedule. They were also instructed not brush their teeth or have breakfast before completing saliva sampling and to avoid contamination with blood caused by micro-injuries of the oral cavity. Subjects stored the saliva samples inside their freezers and then return them to the laboratory. Salivary cortisol was analyzed on a Modular E-170 immunoanalyzer of Roche Diagnostics.

Heart Rate Variability

ECG signal was continuously recorded using a digital Holter device (HCAA 348, Servicios Computados S.A., Buenos Aires, Argentina), during rest and relaxation periods. Effects of transitions at the beginning of each exercise were reduced by omitting the first minute of each exercise. The time elapsed between R peaks of the QRS complex (RR interval) was computed and premature and lost beats were replaced by RR intervals resulting from linear interpolation [22]. Time domain HRV analysis included RRm (mean duration of RR intervals in ms), which quantifies the mean heart rate; SDNN (standard deviation of RR intervals in ms), which quantifies overall variability; and RMSSD (square root of the mean squared differences of successive normal RR), which measures short-term heart rate variations associated with parasympathetic activity [22]. Frequency domain (spectral) measurement of HRV were obtained by Fast Fourier Transform, and included total spectral power (TA, 0-0.4 Hz, ms^2), very low frequency power (VLF, < 0.04 Hz, ms^2), low frequency power (LF, 0.04-0.15 Hz, ms^2), high frequency power (HF, 0.15 - 0.4 Hz, ms^2) and their percentage values. In short-term recordings, changes in mean heart rate are the major constituent of VLF [22].

LF is related to baroreflex control and depends upon sympathetic and parasympathetic mechanisms. HF is related to respiratory sinus arrhythmia and mediated solely by parasympathetic activity. HF fluctuations of heart rate are believed to reflect respiration driven vagal modulation of sinus arrhythmia, through a central coupling of respiratory oscillators with cardiovascular centers. A

mechanical cardiopulmonary reflex mediated by the parasympathetic branch of the efferent pathway has also been suggested as a source of respiration-related HRV [13]. It must be noted that HF fluctuations usually reflect cardiac vagal tone but they are not equivalent measures. For example, respiratory parameters can confound relations between cardiac vagal tone and HF power [23]. Indeed, certain circumstances like relaxation states achieved through meditation, lead to low breathing frequencies and phase synchronization of cardiovascular and respiratory oscillations, which are associated with a pronounced increase of LF power [24]

HRV measures should be considered carefully in ascertaining the clinical condition of a single subject. Nonetheless, as a marker of vagal activity, low HRV predicts hypervigilance and inefficient allocation of attentional and cognitive resources. In addition, decreased HRV has been shown to be associated with a range of psychological and somatic pathological conditions, including depression and cardiac, metabolic and immune dysfunction [25].

Statistical analysis

Data are expressed as mean \pm standard deviation (SD). Missing data were treated as such and no imputation techniques were used. Difference in gender between groups was assessed by the Fisher exact test. Differences in numerical variables between groups were assessed by the Mann-Whitney U test for independent samples. Within each group, differences in numerical variables before

and after relaxation were assessed by the paired-samples Wilcoxon test. A p-value of less than 0.05 was considered significant. All reported p-values are two-tailed. The Statistical Package for Social Sciences (SPSS: version 17.0) was used for data analysis.

Results

Table 1 shows the demographics characteristics of the sample. The trained group comprised 12 (57%) subjects while the untrained group comprised 9 subjects (43%). One of the female participants did not provide information regarding experience in mind-body training, so she couldn't be allocated to any of the groups. No significant differences were found between groups for age, gender or BMI. The untrained group consisted of six physicians, two psychologists and one nurse. The trained group consisted of five physicians, two psychologists, four social workers and one nurse. All participants had at least 8 years' experience in palliative care work. Subjects from the trained group reported experience in the practice of Hatha Yoga for at least one year and up to five years ($n = 8$), or well in the practice of related techniques such as diaphragmatic breathing or creative visualization for at least two years and up to 8 years ($n = 4$). All of them were still practicing some kind of relaxation technique at the time of the study, with at least one-hour of weekly practice. None reported problems with compliance with the techniques.

Although each participant completed at least one of the measures, data that could not be allocated to any of the groups was treated as missing data for all measurements. Reasons for non-completion were not systematically monitored, but most of the subjects declared lack of time due to the presence of other commitments, including patient care.

Table 2 shows the psychological profile of the subjects. The questionnaires were returned by 13 (59%) subjects, 6 (50%) trained and 7 (78%) untrained. No significant differences were found between groups.

Analyzable baseline salivary cortisol samples were provided by 19 (86%) participants; 10 (83%) trained and 9 (100%) untrained. Baseline salivary cortisol levels were significantly higher for the untrained group ($5.23 \pm 5.16 \mu\text{g/dl}$) compared with the trained group ($0.57 \pm 0.20 \mu\text{g/dl}$) (Mann-Whitney U test = 0; $p < 0.001$).

Table 3 shows HRV analysis during rest and relaxation. ECG recordings were obtained from 17 (77%) participants; 9 (75%) trained and 8 (89%) untrained. When comparing HRV values during rest to HRV values during relaxation within each group, trained subjects showed significantly lower levels of VLF ($z = -2.310$, $p = 0.021$), marginally significant lower levels of VLF % ($z = -1.955$, $p = 0.051$) and significantly higher levels of LF% ($z = -2.073$, $p = 0.038$). Untrained subjects showed significantly lower levels of VLF ($z = -2.100$, $p = 0.036$) and significantly

higher levels of HF% ($z = -2.100$, $p = 0.036$). No significant differences were observed between groups, either during rest or during relaxation.

Discussion

This study investigated anxiety, anger, baseline salivary cortisol levels and autonomic nervous system activity in two groups of palliative care professionals, with or without training in mind-body techniques. Lower levels of baseline salivary cortisol and a differential autonomic response to relaxation were found in the trained group (those who had practiced a mind body technique for at least one year).

According to the STAI [17] and STAXI [19] classifications all the participants had moderate anxiety and low anger levels. Although no differences were found in anxiety or anger levels between groups, trained professionals who had used mind body techniques for at least year had lower morning baseline cortisol levels than the untrained group. Indeed, studies suggest a divergence between self-report and physiological measures of stress or emotion in people with normal psychophysiological activation [26].

Observed differences in morning baseline cortisol levels are consistent with the idea that mind-body techniques are an effective tool for health improvement

and stress prevention [27]. In addition, studies support the fact that diaphragmatic breathing and meditation reduce cortisol levels. Martarelli et al. [28] demonstrated that relaxation induced by diaphragmatic breathing increased the antioxidant defense status in athletes after exhaustive exercise, and these effects correlated with the concomitant decrease in cortisol. Cortisol levels found in the untrained group were high compared to literature values [10]. Possibly, these subjects have not enough resources to cope with this kind of stressful work environment, thus promoting a dysregulation in their HPA axis.

In contrast to other authors, who reported that work stress is associated with an altered autonomic profile [29-30], our study found no differences in the parasympathetic activity between groups. Due to the small sample size, we cannot exclude the possibility that this finding could be due to a type II error, especially for HF%. If this were the case, differences observed in the experienced professionals would be attributable to an increased basal parasympathetic predominance because of training in mind-body techniques [30].

Interestingly, when we assessed the autonomic response to relaxation instructions, we observed an increase in HF% without an increase in absolute HF power in the untrained group. This may reflect a shift towards parasympathetic predominance associated with an increase in cerebral alpha rhythm typical of wakefulness with closed eyes [32], while a similar breathing pattern is maintained. In the trained group, we observed a decrease in VLF% associated with an increase in LF%, rather than the prominent peak in absolute LF power usually found during

the relaxation response in meditation derived from Qigong, Yoga [33], and Zen [34-35] traditions, as well as during rosary prayer [36]. This result could reflect the particular level of practice of these subjects, since the tendency towards cardiorespiratory coupling may be a function of the years of meditation experience [37]. The differential physiological response to relaxation between the two groups suggests that untrained people were able to achieve a standard relaxation response, as evidenced by the increase in HRV parameters associated with parasympathetic predominance; while mind body practitioners achieved a deeper state of relax, as suggested by an HRV pattern analogous to that seen during cardiorespiratory synchronization.

There are several limitations in this study. Only a small number of participants were examined. It is thus possible that some associations could have been missed, especially for the psychological profile variables where completion rates were around 60%. Another major limitation is the single cortisol measurement. Although a strict reference to the time of awakening was provided to the subjects, relying on only one measure of morning cortisol could have reflected inter-individual differences in the cortisol awakening response that could weaken the value of our results. Therefore, even if the magnitude of the difference between groups is large, it should be interpreted with care [38-39]. In addition, several factors may explain the observed differences in cortisol values, including stressors of the previous day and sleep quality experienced the previous night, but were not assessed in this study. On the other hand, the precise impact of respiratory influences in the observed results can only be determined by controlling for

respiration, which should be measured in future studies to obtain more reliable HRV data. Finally, the degree of mind body training, the type of training, the amount of regular practice and the duration of practice was not standardized in the trained group and this may account for individual differences obtained.

To conclude, subjects who regularly practice mind-body techniques had lower baseline cortisol levels and achieved a differential relaxation response, similar to the previous studies on meditation [33-37]. Mind-Body interventions include deep breathing, guided imagery techniques, yoga and different styles of meditation. The present pilot study adds evidence for the use of these techniques as an effective self help approach for reducing stress, particularly in a stressful clinical environment.

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Conflict of interest

The authors have no conflicts of interest to declare.

Authors

All research done by the authors

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Table 1. Demographic characteristics

	Trained (n = 12)	Untrained (n = 9)	Statistics *
Age (yrs)	44 ± 12	45 ± 13	U= 36, p = 1
Female	11 (92%)	8 (89%)	p = 1
BMI (kg/m ²)	24.0 ± 3.7	24.1 ± 4.4	U = 14, p = 0.931

Values expressed as mean ± SD or frequency (%). BMI: Body Mass Index. *Mann-Whitney U test (age and BMI) or Fisher's exact test (gender).

Table 2. Psychological variables

	Trained (n = 6)	Untrained (n = 7)	Statistics *
Anxiety state	37 ± 5	35 ± 10	U = 11.5, p = 0.181
Anxiety trait	40 ± 8	37 ± 6	U = 16.0, p = 0.534
Anger state	11 ± 2	11 ± 1	U = 16.0, p = 0.534
Anger trait	16 ± 4	18 ± 4	U = 14.0, p = 0.366
Anger in	15 ± 2	14 ± 4	U = 19.5, p = 0.836
Anger out	16 ± 5	14 ± 4	U = 17.5, p = 0.628
Anger control	23 ± 3	21 ± 2	U = 14.0, p = 0.366

Values expressed as mean ± SD. * Mann-Whitney U test for independent variables.

Table 3. Heart rate variability analysis

	Trained (n = 9)			Untrained (n = 8)		
	Rest	Relaxation	Statistics *	Rest	Relaxation	Statistics *
RRm (ms)	778 ± 94	783 ± 78	z = -0.059 p = 0.953	717 ± 198	734 ± 177	z = -1.540 p = 0.123
SDNN (ms)	40 ± 12	38 ± 12	z = -1.599 p = 0.110	52 ± 44	47 ± 44	z = -1.400 p = 0.161
RMSSD (ms)	33 ± 13	34 ± 16	z = -0.178 p = 0.859	50 ± 73	49 ± 69	z = -0.420 p = 0.674
ln TP (ms ²)	7.2 ± 0.7	7.0 ± 0.9	z = -1.481 p = 0.139	7.4 ± 1.1	7.1 ± 1.4	z = -1.260 p = 0.208
ln VLF (ms ²)	6.4 ± 0.9	5.5 ± 1.4	z = -2.310 p = 0.021	6.4 ± 1.1	5.7 ± 1.2	z = -2.100 p = 0.036
ln LF (ms ²)	5.8 ± 0.7	5.9 ± 1.0	z = -0.178 p = 0.859	6.4 ± 1.1	6.1 ± 1.4	z = -.980 p = 0.327
ln HF (ms ²)	5.7 ± 1.1	5.7 ± 1.0	z = -0.296 p = 0.767	5.4 ± 1.6	5.5 ± 1.7	z = -0.840 p = 0.401
VLF (%)	48 ± 17	31 ± 19	z = -1.955 p = 0.051	41 ± 20	30 ± 14	z = -1.260 p = 0.208
LF (%)	26 ± 9	38 ± 19	z = -2.073 p = 0.038	43 ± 22	42 ± 24	z = -0.980 p = 0.327
HF (%)	26 ± 15	32 ± 19	z = -0.770 p = 0.441	17 ± 12	28 ± 19	z = -2.100 p = 0.036

Values expressed as mean ± SD. * Differences within groups between rest and relaxation were assessed through the Wilcoxon signed-rank test. Differences between groups were assessed through the Mann-Whitney U test for independent variables; p = ns for all variables (not shown). RRm, mean RR interval; SDNN, standard deviation of all normal RR intervals; RMSSD, square root of the mean squared differences of successive normal RR; TP, total spectral power; VLF, very low frequency power; LF, low frequency power; HF; high frequency power.