

Improving the well-being of cancer hospitalized patients: SENTIR meditation program

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Abstract. *Background and aim:* The present work aims to develop, implement, and evaluate the effectiveness of a health/wellness promotion program, based on mindfulness meditation, sensory stimulation and virtual reality, with oncology patients in hospitals. *Methods:* We developed an intervention study, with pre and post-test quantitative assessment, complemented with qualitative data. The intervention included six personalized sessions combining guided meditation, sensory stimulation, and virtual reality. Twelve cancer patients participated (83.3% female) with a mean age of 33.7 years (SD= ±13.0) receiving treatment at a Cancer Treatment Hospital. Physiological (heart rate, blood pressure and oxygen saturation), and psychological parameters (DASS21) were used. *Results:* The comparison of the physiological parameters, before and after the sessions, revealed a statistically significant increase in oxygen saturation ($p=0.03$) after the first session. Regarding the levels of anxiety, stress, and depression, they significantly decreased ($p<0.01$) after the intervention. Qualitative data reinforced these positive results. *Conclusion:* The implemented intervention proved to be effective in reducing psychological vulnerability and partially effective in physiological measures. It is concluded that the program promotes the well-being of cancer patients in a hospitalized situation, favoring better coping with the disease.

Key words: Cancer; Stress, Anxiety, Depression, SENTIR meditation program; Well-being, Virtual reality

Introduction

Cancer illness is highly stressful, causing, beyond the shock of diagnosis, many physical symptoms (e.g., pain, fatigue, nausea) and psychological distress (e.g., fear, confusion, depression, anxiety, irritability) with high impact on patients' quality of life (1-3). The recovery process is usually marked by states of heightened arousal following real or perceived threats which very often feeds a negative affect loop (4).

Alongside pharmacological interventions, complementary therapies such as yoga are increasingly

recognized to help patients deal with disease's symptoms (5-10). In hospital setting, occupational interventions based on imagery, music, relaxation, arts, meditation, among others, have been introduced and seem to help patients to cope with more intrusive cancer treatments (11).

Meditation is one of the complementary alternatives that positively influences rehabilitation, reducing pain, stress, anxiety, depression, fatigue and even the adverse effects caused by treatments. Mindfulness-Based Stress Reduction (MBSR) is the most known and investigated program worldwide and

mindfulness-based approaches are increasingly applied due to the beneficial effects they exert on the reduction of stress and health promotion (12-14), including cancer patients (15-18). However, group and long interventions, like MBSR (8 weeks), are limited in the case of highly vulnerable hospitalized patients receiving treatment in wards. Short and personalized sessions combining mindfulness meditation with sensorial stimulation may be a promising alternative therapy improving cancer patients' well-being in a hospital setting. While maintaining the benefits of mindfulness, sensory stimulation is thought to enhance its gains, through facilitating patients to be fully present and so preventing mind wandering, such as a wandering mind is an unhappy mind (19).

Most of the meditative programs are described as concentrative meditation, such as transcendental meditation, or mindfulness meditation such as mindfulness-based stress reduction; however, this distinction may not differentiate the effects of the techniques. The effectiveness of these interventions may vary among different subgroups such as those with a particular clinical condition (e.g., anxiety or pain) (20). The effects of the movement-based meditative techniques such as yoga, reiki, tai chi, and qi gong on stress outcomes are influenced by the ancillary beneficial effects of exercise and movement components on stress outcomes. Although these techniques also contain a meditative component, it is often difficult to ascertain the effects of meditation itself on stress outcomes, separate from the effects of the exercise component (21-23).

Mindfulness is a state of consciousness associated with paying attention, non-judgmentally, to the present moment, being the person aware of what is happening moment-by-moment (24-25). It implies self-regulation of attention, to maintain the focus on immediate experiences (such as sensations, thoughts, emotions), and the ability to approach experience with curiosity, openness, and acceptance (13, 25-26). There is emerging evidence that intentional mindfulness decreases self-referential processing (less activation of the default mode network) associated with rumination and worry. Mindfulness practices also support decentering, emotion regulation, focused attention, and decreased aversion to negative feelings, all of which can lead to an increase in well-being and to less mental agita-

tion (21, 27-29). Neuroscience research supports the healthy mindfulness skills of present-moment focus and detachment from self-referential processing with less engagement in mind-wandering and rumination (14,30). The benefits of mindfulness are also stressed by physiology. It seems to directly modulate stress processing via a bottom-up pathway, increasing activity in the parasympathetic nervous system and, oppositely, preventing sympathetic fight-or-flight stress responses (13,31). Sensory stimulation also appears to reinforce the bottom-up emotion regulation pathway (e.g., activating certain types of non-cognitive response modification strategies, such as relaxation). Furthermore, some studies found that meditators showed coherence between objective physiological data and their subjective experience regarding emotional experiences (13, 32-23).

In sum, meditation helps patients to decentre without adding further negative valence brought on by concern for the future, improving psychological health and physical condition. These benefits coupled with those of sensory stimulation and virtual reality lead us to conceive and test an innovative health intervention program fitted to cancer patients receiving treatment in a hospital setting. This understanding of stress, as a psychophysiological response of the organism, is fundamental, as it favors the diagnosis of the responses that are triggered by the way stimuli are processed (34).

Thus, the investigation of new intervention approaches focused on counteracting the negative physical and/or psychological side effects of cancer treatment seems justified (35). Virtual reality (VR) appears, which is a computer-generated environment, widely used in the entertainment world and has been carried out in several interventions in the biomedical field, especially in cancer patients, during rehabilitation and at hospital discharge (36). VR is a technology that constitutes an important aid in several areas, as it encompasses the health sciences, related to intervention, favors the support of diagnosis, management, education and health, as well as in therapeutic processes (37,38). The use of VR in rehabilitation promotes light and also moderate levels of activities in patients in the intensive care unit (35) and is gaining more supporters, finding applications in rehabilitation, neurology, among other fields, has also been widely adopted in the reha-

bilitation process and it has been shown to be highly effective in improving cognitive and motor functions showing successful results in treatments for different mental health conditions (35,40-43).

Thus, this research aimed to develop, implement, and evaluate the effectiveness of a health promotion program (SENTIR meditation program), based on virtual reality, in patients during cancer treatment.

Materials and Methods

Study: Analytical study, with evaluation before and after the intervention (pre and post-test), which evaluated the impact of the SENTIR meditation program on anxiety, depression, stress and on physiological parameters of cancer patients.

Participants: The study involved a total of 12 patients, hospitalized for cancer treatment with the inclusion criterion being a length of stay greater than 13 days. Those who withdrew from participating in the research or who would be discharged before the end of the intervention sessions were excluded. All 12 patients agreed to participate in the study by signing the Free and Informed Consent Form. Most participants are female (83.3%), with a mean age of 33.7 ± 13.0 years and prevalence in the age group between 32 and 46 years (50.0%); married and single (50.0 %, each), most have completed elementary school (33.3%), do not have children (41.7 %) and are farmers (33.3%).

Measures: Anxiety, Stress and Depression Scale (DASS-21) Brazilian version (44-45). It is a self-report scale, with three integrated subscales: Depression (items 3, 5, 10, 13, 16, 17, 21), Anxiety (items 2, 4, 7, 9, 15, 19, 20), and Stress (items 2, 4, 7, 9, 15, 19, 20). items 1, 6, 8, 11, 12, 14, 18). It has four possible responses in terms of severity or frequency, organized on a scale from 0 to 3. The result is obtained by summing the item scores for each of the three subscales.

Physiological parameters: systolic and diastolic blood pressure, O_2 saturation and heart rate, before and after each session of the intervention program.

Protocol Procedure: The first assessment was carried out, and the participants were given the informed consent, and filled the Sociodemographic and the DASS-21 questionnaires. The health promotion pro-

gram was designed and implemented, based on VR, using meditation with sensory stimuli - Meditation SENTIR program. Before and after each session, the clinical parameters were evaluated (heart rate, blood pressure and O_2 saturation). After each session, qualitative information was collected about the experience. After the complete intervention, the DASS-21 Scale was applied again.

Intervention Procedure: The intervention took place over three weeks and two days, totaling 48 sessions, held in the ward where the patient was hospitalized. Each session consisted of guided meditation, using VR and sensory stimulation, lasting approximately 20 to 30 minutes. Six personalized guided meditation sessions, with virtual reality and sensory stimulation were available for patients to choose. Four sessions with each of the 12 patients were carried out, which gives a total of 48 sessions. The researcher produced the images of nature in 360 degrees and with special effects (visual sensory), designed for each meditation. For the preparation of the sessions, a prior collection of the preferences of each patient and the situations that triggered serenity and well-being was carried out. The sessions were designed in a personalized way. Each patient chose a place where they would like to "be" (rivers, plantations, beach, sea, sunset and others) and four meditations among the options: 1- Be bigger; 2- Live in the moment; 3- Full happiness; 4- Angels; 5- Peace and serenity; and 6- Gratitude.

After choosing the meditations, the environment was prepared, with *Wi-Fi equipment*, Virtual Reality glasses and sensory stimuli. During the sessions, stimuli were added such as: aromas (lavender, lemon, cherry, etc.), touches with soft textures, balls for massages and massagers, sounds (nature music, birds, waterfalls). Sensory stimulation was used to make immersive images (viewed with virtual reality glasses) more real. These stimuli were chosen according to the preferences reported by the patients during the listening phase. The meditations were guided according to the themes and images inserted into the VR glasses. Each meditation had a structured sequence (beginning, middle and end), including breathing, tactile experiences (such as the patient's embrace with himself - deep touch) and soft touches (with various materials) placed by the researcher. In addition, the researcher's voice modulation in the

orientation of the sensory experience should be mentioned, who, through a mobile phone, which mirrors the VR, sees what the patient sees during the session. The first step is to place the patient in a comfortable position, he can be lying down, sitting, whichever is better, according to the clinical conditions. Then the glasses are put on and throughout the session the patients are instructed to focus on their breathing and various sensory stimuli are introduced to facilitate immersion in the chosen meditation (images, sounds, smells/aromas, touch). It is intended that patients are focused on the moment, with full attention and the researcher's voice guides them towards tranquility. Intense immersive experiences are generated allowing patients to decenter themselves from the place where they are.

Statistical analysis: Data were analyzed using the SPSS 21.0® program. Numerical variables were presented as mean and standard deviation and categorical as absolute (n) and relative (%) frequencies. Normality was verified using the Shapiro-Wilk test. To compare the pre- and post-intervention means, the Wilcoxon test for paired samples was applied. Differences between groups were considered significant when $p < 0.05$.

Ethical procedures: This research was approved by the Ethics and Research Committee of UFMA under number 4,316,346 and CAAEE 38058220.0000.5087.

Results

The most prevalent diagnosis was uterine cancer (58.3%), most patients are not in palliative care (83.3%). Regarding the preferences questioned to guide the sensorial experiences in meditation, in the smells, the sweet aroma predominated (58.3%) and regarding the places of nature where they would like to be, the preference was the beach (50.0%) (Table 1).

Physiological Parameters

When comparing the results obtained before and after each session, no statistically significant differences were observed, with the exception of O_2 saturation, whose value increased ($p=0.03$) after the intervention of the first session. Before the intervention, O_2 saturation was $93.8\pm 2.5\%$, increasing to $94.7\pm 2.9\%$ after the in-

Table 1. Clinical features and sensory preferences

Variables	no	%
Diagnosis		
Uterine cancer	7	58.3
Breast cancer	1	8.3
adenocarcinoma	1	8.3
squamous cell carcinoma	1	8.3
osteosarcoma	1	8.3
Ewing's Sarcoma	1	8.3
Palliative care		
Yes	2	16.7
No	10	83.3
Preference to smells		
Sour	1	8.3
Citric	3	25.0
Sweet	7	58.3
Jasmine and wood	1	8.3
Preference to locations		
Beach	6	50.0
River	5	41.7
Farm	1	8.3
Total	12	100.0

tervention. Normal values are between 95% and 100% (Dias et al, 2020). When we compare the mean values of O_2 saturation between sessions, the results indicate that from session 1 to session 4 there was an increase. Before session 1, O_2 saturation was $93.8\pm 2.5\%$ and before session 4 it was $95.1\pm 2.4\%$. After session 1, O_2 saturation was $94.7\pm 2.9\%$ and after session 4 it was $95.5\pm 2.3\%$. (Table 2).

Depression, anxiety, and stress

When comparing the mean values of the depression, anxiety, and stress scales (DASS-21), before and after the intervention, statistically significant differences ($p=0.002$) were observed in the three subscales. In the Depression subscale, there was a decrease in the mean value, from 12.7 ± 8.0 to 2.3 ± 3.0 points. In the Anxiety subscale, there was a decrease in the mean value, from 9.9 ± 5.6 to 2.1 ± 2.2 points. Finally, in the Stress subscale, there was a decrease in the mean value, from 14.1 ± 6.3 to 1.9 ± 2.1 points (Table 3).

Table 2. Comparison of physiological parameters before and after each session

Variables	Pre-intervention	Post-intervention	p* value
	Md±SD ⁵	Md±SD ⁵	
session 1			
Pas ¹ (mmHg)	116.7±19.9	121.0±22.2	0.593
Pad ² (mmHg)	69.1±8.0	73.0±15.0	0.785
FC ³ (bpm)	88.6±17.1	89.0±15.7	0.550
SaO ₂ ⁴ (%)	93.8±2.5	94.7±2.9	0.034*
session 2			
Pas ¹ (mmHg)	125.4±26.8	122.9±29.0	0.168
Pad ² (mmHg)	82.2±15.9	80.6±14.6	0.465
FC ³ (bpm)	96.3±12.2	96.8±10.8	0.857
SaO ₂ ⁴ (%)	93.8±3.1	94.1±2.8	0.180
session 3			
Pas ¹ (mmHg)	137.0±29.3	134.3±24.7	0.893
Pad ² (mmHg)	85.1±17.9	87.7±18.3	0.104
FC ³ (bpm)	94.7±14.0	95.1±11.7	0.143
SaO ₂ ⁴ (%)	94.9±3.6	94.6±3.3	0.414
session 4			
Pas ¹ (mmHg)	132.3±28.6	125.0±23.3	0.465
Pad ² (mmHg)	88.4±23.0	87.3±17.9	0.674
FC ³ (bpm)	87.6±13.2	87.6±12.8	0.723
SaO ₂ ⁴ (%)	95.1±2.4	95.5±2.3	0.083

¹ Systolic Blood Pressure; ² Diastolic Blood Pressure; ³ Heart rate; ⁴ O₂ saturation; ⁵ Mean ± Standard deviation; *Wilcoxon test; *p value <0.05.

Discussion

The main objective of the present work was to design, implement and evaluate the effectiveness of a health promotion program, based on virtual reality, in cancer patients during cancer treatment. The quantitative results obtained show that the intervention was effective in reducing stress levels, anxious and depressive symptoms.

Regarding the first objective in the assessment of stress, anxiety and depression levels, the results obtained showed high levels of stress, anxiety, and depres-

sion. In a study developed with 190 women with breast cancer (46), the mean results obtained with the DASS-21 scale were for depression, anxiety and stress, respectively (6.7±4.9; 6.7±4.3 and 8.9±5.1). As we can see, the values obtained were lower than those found in our study, which can be explained by the sociodemographic characteristics of the sample, which is mostly married (84%), which may imply a larger support network. Factors such as place of residence can influence the results, with most of the sample living in the interior of the state, working in the countryside and, when hospitalized, the rules, norms and people who are not familiar with them can feel anxious and with more stress.

Regarding the reduction of stress, anxiety, and depression levels with the VR-based intervention - SENTIR meditation program, the results showed that there was a statistically significant decrease in the mean values of the three dimensions. In line with our results, a study carried out with 36 patients diagnosed with breast cancer, allowed the authors to conclude that after the intervention (Mindfulness-Based Cognitive Therapy - TCBMF) there was a significant decrease in the three DASS-21 subscales, and understand that knowledge and understanding of mindfulness through meditation practices, through TCBMF, can help increase patients' self-awareness and self-acceptance. However, although the TCBMF was not used, the "Feel" Meditation obtained similar results (12). The level of stress and pain during the procedure of fully implanted catheter insertion in 23 adolescents undergoing cancer treatment, with and without VR use, concluding that VR proved to be an important stress reduction mechanism, as the group that used VR, compared to the group that used distraction strategies, presented lower levels of stress and pain during the procedure (47).

Another study evaluated the effect of Reiki technique on pain, anxiety and fatigue in cancer patients, found that the degree of stress in the first evaluation in the experimental group was 4.25±1.98 and after Reiki practice, the mean stress score of the experimental group decreased (1.37±0.74), and statistically significant differences were observed (p <0.001), which corroborates our findings on the positive influence of meditation on the levels of stress (48). Taking into account the practice of alternative therapies, another

Table 3. DASS-21 Pre- and Post-test comparison

DASS scales ¹	Initial	Final	p* value
	Md±SD	Md±SD	
Depression	12.7±8.0	2.3±3.0	0.002**
Anxiety	9.9±5.6	2.1±2.2	0.002**
Stress	14.1±6.3	1.9±2.1	0.002**

¹ Depression, Anxiety and Stress Scale; ⁵ Mean ± Standard deviation; *Wilcoxon test; **p value <0.01.

study using the DASS-21 scale, found that the practice of yoga in 15 cancer patients led to a significant decrease in the depression scale (5).

The SENTIR program meditation significantly reduced the participants' stress levels, which corroborate one study that the effect of meditation on breast cancer survivors, although using a different scale to analyze the level of stress, concluded that the practice of meditation for eight weeks was able to significantly reduce physical stress in the last 24 hours ($p=0.002$), in the last week ($p=0.0009$) and in the last month ($p=0.046$), the same happening with psychological stress, which also showed a reduction in the last 24 hours ($p=0.02$) in the last week ($p=0.009$) and in the last month ($p=0.03$) (49).

One comparison between three groups: Meditation Test group and Placebo Test and Educational Test groups, show that carrying out an intensive Meditation program reduces stress in healthy adults, suggesting it as a clinically effective treatment. Regarding the effects of interventions on heart rate, blood pressure and O_2 saturation, the results showed that there were no significant changes in the parameters evaluated, except for oxygen saturation, in the first session (50).

Some authors investigated how the qigong technique, as a psychotherapeutic method, is effective in improving physiological deficits such as plasma cortisol level, electrodermal reaction, temperature of the palms and blood oxygen saturation, in breast cancer survivors, and observed post-intervention improvement in all parameters evaluated (6). Regarding oxygen saturation, the study found results like our findings, noting that the saturation value before the intervention (91.06 ± 2.42) is significantly lower than the post-intervention condition (94.77 ± 2.02), with p value = 0.000, suggesting better oxygenation after the intervention.

One study revealed a statistically significant increase (pre= 89.33 ± 3.23 ; post= 90.74 ± 2.65) when comparing the saturation after the intervention corroborating our results, however, similarly in our study, the authors did not find differences statistically significant in systolic and diastolic pressures, as well as in the pulse assessment performed by the study. Regarding SBP, the study found a reduction in the parameter (initially from 145.14 ± 18.79 to 142.23 ± 19.49 after intervention), which was also observed in our study (51).

With an analysis of the result of the effectiveness of meditation on BP values, did not observe a significant drop in this parameter in patients undergoing meditation, verifying that the intervention group had SBP and DBP of 135.0 ± 8.4 and 82 ± 6.2 mmHg, respectively, and the control group had SBP 134.0 ± 7.4 and DBP 82.0 ± 5.3 mmHg, the fact may have occurred because the randomized clinical trial was carried out with hypertensive patients and possibly meditation would not improve the condition in individuals with chronic diseases (32).

The results obtained indicate a tendency towards the intervention with VR to contribute to the increase in oxygen saturation. We believe that using a larger sample could contribute to more robust results. The immediate emotional responses may be the result of the concentration process of meditation itself (1). When there is an integration of memories, there is a greater intensity of responses, resulting in more flexible and revealing emotional cognitive interpretations, these emotions act directly on the blood pressure, heart rate and oxygen saturation levels of individuals.

We must highlight the small number of participants in the sample, because of the COVID-19 pandemic as a bigger limitation of this study. Other limitations are related to the pathology of the study participants, such as the occurrence of several postponements of the sessions (or the time of the same), due to the clinical status of the patients (drowsy, sick, unwell), surgeries or transfers to the ICU, factors that hampered the implementation of the intervention.

Although the sample of patients is very limited, we intend to follow this group of patients to obtain a medium-term follow up that can enforce the clinical encouraging results. We also intend to replicate the application of the SENTIR Meditation program in a larger sample in a longitudinal study, in order to reinforce the clinical and psychological benefits of its application.

As aspects to be valued, we emphasize that it was essential to respect the individuality and clinical status of patients, plan the sessions in a personalized way and use VR associated with sensory stimulation, as a strategy to promote positive emotions. It should also be noted that the *feedback* from the participants and their willingness to continue participating in the SENTIR Meditation program was very gratifying.

Conclusion

The main results obtained with the SENTIR meditation program show that there was a significant decrease in the levels of depression, anxiety, and stress after the intervention. The use of VR goggles as an occupational therapeutic resource was an important asset, as it intensifies the senses, giving greater liveliness to meditation. The use of sensory stimuli favored the immersion process, triggering positive emotions, a fact that was corroborated by the patients in their testimonies, referring to feeling peace, tranquility, joy, gratitude, among other aspects. They also highlighted that they managed to blur the disease and maintained full attention to the moment, which demonstrates the effectiveness of the technique.

In the SENTIR Meditation program, in addition to the visual stimulus, other senses were stimulated with meanings for the patients (for example, aromas that generate in the memory a feeling of peace and happiness). This meditation is based on some concepts of occupational therapy (professional area of the first research author), such as the choice of meaningful activities and individualized planning since each patient is unique.

In the future, studies will be needed that prospectively address the influence of the VR approach on the reduction of stress, anxiety, and depression, as well as on the quality of life of cancer patients. Regarding the physiological parameters, we believe that it would be important to increase the number of participants studied, as well as the duration of the intervention, to obtain more and robust results.

Finally, we emphasize that the use of VR glasses, in therapeutic contexts, is an important resource in the health area, showing promise in this and other approaches. Its use, in the present study, contributes to reducing negative emotions associated with the disease and favored a better coping with it.

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