

Virtual body and emotions: A pilot study on the use of virtual reality for the management of unpleasant sensations after cancer

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Abstract

Background: Women who receive a breast cancer diagnosis often have to cope with physical and psychological issues, even some years after diagnosis and treatments. Physical changes and negative inner sensations damage body image, leading to reduced contact with the body and social relationships due to shame and increased fear of cancer recurrence. Several psychological interventions have been conducted to manage psycho-emotional issues involving bodily sensations and emotions.

Aims: This study aimed to propose a virtual reality (VR) intervention to improve awareness and management of bodily sensations.

Materials and Methods: Thirteen women participated in a study design in which they were guided to focus their attention on three different parts of their body (i.e. arms, chest and legs) in a randomised way. Participants followed a light as a virtual visual stimulation and heard the researcher's voice.

Results: Findings showed that physical discomfort and negative emotions related to the body significantly decreased after the VR intervention. Additionally, the present VR intervention decreased anxiety. Accordingly, women qualitatively stated being satisfied with the intervention, considering VR as a helpful tool to be more focused on their inner sensations and decrease discomfort.

Discussion: In conclusion, VR may be implemented to promote bodily awareness in women with a breast cancer diagnosis, improving bodily awareness and the management of negative emotions.

Conclusion: Directions for future research and clinical implications are given.

KEYWORDS

breast cancer survivors, fear of cancer recurrence, interoception, virtual reality

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1 | INTRODUCTION

Virtual reality (VR), as a tool that allows users' immersion into a virtual environment, could promote a process of embodiment and a sense of presence thanks to the combination of visual and tactile stimulations. Users can perceive their real and virtual bodies simultaneously (*self-identification*) in a specific space (*self-location*), increasing a sense of belonging (Nakul et al., 2020; Ventura et al., 2018). Nowadays, VR is applied in different areas of clinical treatment, including the oncological field. Research findings suggest that integrating VR into medical treatments can significantly improve therapeutic outcomes and extend their durability over time (Pittara et al., 2020). For example, after an oncological diagnosis, people may experience negative emotions and feelings (such as anxiety, fear and stress), which may affect their quality of life and can persist for a long time (Sebri et al., 2024). In this area, VR could help patients to manage their negative emotions and physical symptoms. For example, studies have shown that immersive VR could help patients to manage their emotional distress during oncological treatments (e.g. chemotherapy), also reducing the experience of pain (Pittara et al., 2020). The exposure to virtual stimulation could help patients to manage or ameliorate procedural pain during invasive treatments (Matsangidou et al., 2017). Additionally, VR is even more prominent in research studies aiming to promote body awareness and regulation of emotional well-being (Slater et al., 2008; So et al., 2022). The physical and psychological issues after diagnosis and oncological treatments can generate difficulties in cognitive and emotional levels in women who have received a breast cancer diagnosis in the past (Durosini, Triberti, Sebri, et al., 2021; Sebri et al., 2019). Specifically, undergoing oncological treatments can lead to the so-called 'chemobrain', which is a cognitive decline due to brain intoxication (Oroian et al., 2022). The symptoms of 'chemobrain' often persist after treatment, leading to difficulties at work and in daily life. At a cognitive level, it can interfere with cognitive skills and flexibility, impacting decision-making processes and increasing emotional issues (Cherifi et al., 2022).

Moreover, the literature has shown that the relationship with the body can also be damaged (Maass et al., 2015; Sherman et al., 2018). After oncological treatments, women may perceive bodily sensations never felt before, increasing their interoceptive awareness (Paterson et al., 2016). Interoception is conceptualised as being aware of one's internal sensations (e.g. hunger and itching). The literature has shown that high interoceptive awareness could regulate internal states to increase a psycho-emotional balance and positive overall self-representations (Herbert & Pollatos, 2012). The focus on internal sensations can become even stronger due to the fear of cancer recurrence. Thus, women with breast cancer tend to constantly control their behaviours, such as looking for breast lumps, with relevant consequences on promoting dysfunctional emotions, anxiety and distress especially (Humphris & Ozakinci, 2008). Being aware of the interplay between external and internal sensations is crucial to support women in recognising their bodily sensations and their related

Implications for practice and policy

- Professionals in psychology, counselling and psychotherapy should carefully consider the impact of inner sensations on patients dealing with chronic diseases, such as breast cancer.
- To effectively meet the needs of breast cancer survivors, it is crucial to understand their sensations and emotions regarding their bodies post-cancer. This understanding can promote their awareness and interest in managing inner sensations and improving their interoceptive abilities.
- Specifically for practitioners in psychology, counselling and psychotherapy, training and supervision should focus on acquiring knowledge in new technologies, such as virtual reality, as an innovative method to achieve a good quality of life.
- Breast cancer survivors are encouraged to actively listen to and take care of their bodies and the associated sensations, as these factors significantly contribute to overall well-being.
- The implementation of virtual reality interventions plays a pivotal role in enhancing bodily sensations for breast cancer survivors. This, in turn, can foster increased attention to bodily awareness and the development of effective self-care practices.

emotions (Czamanski-Cohen et al., 2019). As a consequence, bodily awareness can increase the acceptance of their own body and its representations, which is defined as body image (Raimo et al., 2021; Sebri et al., 2022). Body image is the internal representation of one's outward appearance, involving its related emotions and thoughts within the bodily self-representation (Lewis-Smith et al., 2018; Sebri et al., 2021; Thompson et al., 1999). When estimating body image, individuals show different bodily perceptions (in terms of accuracy of one's body size), feelings and emotions, attitudes (e.g. the level of satisfaction related to the body), beliefs and thoughts, and behaviours (e.g. compensatory behaviours to achieve a good self-image) (Cash & Smolak, 2011). The integration of interoceptive and exteroceptive sensations is fundamental to better define body image (Badoud & Tsakiris, 2017). Accordingly, at a cognitive level, bodily issues can create a dissonance between current and ideal self-images, inducing concerns and discomfort. This is in line with Higgins' discrepancy theory (1987), which points out the relevant increase in anxiety and depression and difficulties in social relationships. Therefore, breast cancer has a strong impact on body image, influencing the interpersonal and intrapersonal relationships with others, as reported in a comprehensive literature review published by Rezaei et al. (2016). Since the breast is a symbol of femininity and sexuality, any damage can cause distress and worry, affecting emotional well-being (Fang

et al., 2015). Additionally, cancer treatment and interventions can result in permanent changes in their aesthetic appearance, decreasing self-acceptance (Sebri, Durosini, & Pravettoni, 2023). In the case of breast cancer, the loss of breasts can harm body integrity, leading to behaviours such as reluctance to look at oneself naked (Martins Faria et al., 2021).

Over the years, several psychological interventions have been implemented to promote interoceptive awareness, from cognitive behavioural to emotional, expressive and educational approaches (Blanco et al., 2014; Savioni et al., 2022; Sebri, Durosini, & Pravettoni, 2023). Current studies have evidenced the relevance of psychological interventions focussed on self-compassion and mindfulness approaches, highlighting the mindfulness-based stress reduction intervention as a tailored intervention to promote kindness and care towards the body after cancer (Chang et al., 2021; Mifsud et al., 2021). However, there is a gap in the literature regarding the implementation of VR for women with a breast cancer diagnosis and the promotion of positive bodily emotions. Following a study protocol published by Sebri, Durosini, Strika, et al. (2023), a VR intervention could aim to promote emotional well-being and regulation thanks to increased awareness of inner bodily sensations. Accordingly, the overall purpose of this research study was to implement VR to improve interoceptive ability and emotional well-being in women who received a breast cancer diagnosis in the past. Specifically, the objectives of the present protocol study aim to evaluate the impact of sensation manipulation through VR on emotions and inner sensations in women who had received a breast cancer diagnosis and related treatments.

2 | MATERIALS AND METHODS

2.1 | Participants

Thirteen adult women with a previous history of breast cancer were included in the study.

All participants lived in Italy with an overall mean age of 50.4 years old ($SD = 8.03$ years), with an age range from 35 to 61 years. The year of the first diagnosis of breast cancer ranged from 2012 to 2022, and six participants (46.2%) were still receiving oncological treatments. Concerning sociodemographic features, 10 participants were in a relationship (76.9%), while three were divorced. Six had a master's degree (46.2%), and the other seven (53.8%) had completed high or middle school.

2.2 | Procedure

Data were collected from March to June 2023 in a laboratory. Participants included in this study were recruited through social networks, breast cancer patient organisations and personal contacts. As a part of the recruitment process, the following inclusion criteria were used: (a) adult women (age 18 years or older); (b) women with a

previous diagnosis of breast cancer (Stages I and II); and (c) women who had been treated for cancer in the past. Conversely, exclusion criteria included those diagnosed with metastatic cancer, those unable to provide informed consent and/or women with poor Italian-language skills.

All the participants were invited to be seated on a chair and to complete a battery of questionnaires using the Qualtrics software (baseline measure). After that, women received a set of instructions about the experiment and were invited to wear an Oculus Quest 2 visor and were asked to observe their virtual bodies in a mirror and pay attention to physical sensations in (a) their hands, (b) their breasts and (c) their feet. The participants were then given visual and audio stimuli. Participants observed near their virtual body a visual stimulation in the form of a light pulsing and changing from red to white. In the meantime, an audio stimulus was provided. Specifically, the experimenter's voice 'directed' women to become aware of and relax the sensations in their hands, breasts and feet, subsequently. Thus, participants were asked to bring awareness to the inner sensations referred to their body. The VR session lasted approximately 15–20 min, and all the participants followed the same protocol. At the end of the VR stimulation, the experimenter ensured the absence of symptoms related to cybersickness in the participants and invited them to complete another set of questionnaires. The protocol was approved by the Ethics Committee of the University of Milan. The confidentiality and the anonymity of the data were guaranteed. No financial reward was offered to participants; participation was voluntary, and women could decide to withdraw from the study at any moment. Participation in the study was allowed after the signing of an online informed consent form prior to data collection. All the procedures were carried out in accordance with the Declaration of Helsinki.

2.3 | Measures

Before the VR experience, participants were invited to complete a battery of questionnaires, as follows:

- *Visual Analogue Scale* (VAS; Price et al., 1983, 2008) with ad hoc questions, asking about the perceived unpleasant sensations referred to their hands, feet and breasts. The VAS ranges from 0 (no pain) to 10 (the worst pain you can imagine).
- *Self-Assessment Manikin* (SAM) for emotional baseline. This is a three-item visual scale commonly used to quantify valence, arousal/intensity and dominance of emotions experienced by participants, through a 1 to 5 scale of images (Bradley & Lang, 1994).
- *State-Trait Anxiety Inventory* (STAI-Y1) (Spielberger, 1983; Spielberger et al., 1983) was also used to assess anxiety as an emotional response, for example tension, worry and negative feelings related to tension. This questionnaire includes 20 items, divided into trait and state anxiety dimensions. Before the VR experience, only the State dimension was administered. The

STAI-Y1 shows better psychometric properties, including good internal consistency, test-retest reliability and construct validity in healthy population samples (REF).

- *The Multidimensional Assessment of Interoceptive Awareness* (MAIA; Mehling et al., 2012) was also administered to participants. The MAIA is a self-report questionnaire that assesses eight dimensions related to interoceptive aspects of body awareness. The scale consists of 32 items rated on a 6-point Likert scale ranging from 0 (never) to 5 (always) and assesses six dimensions: *Noticing*, related to awareness of unpleasant, pleasant and neutral bodily sensations; *Not-Distracting*, related to the tendency to ignore unpleasant body sensations; *Not-Worrying*, related to the tendency not to ignore or distract from pain; *Attention Regulation*, related to the ability to coordinate attention across multiple bodily sensations; *Emotional Awareness*, the ability to be aware of the relationship between physical states and emotional states; *Self-regulation*, related to the ability to direct attention to physical states to regulate psychological distress; *Body Listening*, related to the active listening to the body for insight; and *Trusting*, related to the experience of feeling safe and secure in one's body.

All the questionnaires were also administered to participants after the VR experience. Additionally, the *Cancer Worry Scale* (CWS; Chirico et al., 2022; Custers et al., 2014) was administered after the VR experience. The CWS was used to measure concerns about cancer disease recurrence in participants. The scale consists of eight items rated on a 4-point Likert scale. Higher scores indicate greater concern about recurrence. Moreover, participants were invited to complete the *ITC-Sense of Presence Inventory* (ITC-SOPI) (Lessiter et al., 2001). The ITC-SOPI is a validated 44-item questionnaire designed to explore users' sense of presence into the virtual environment, namely the extent to which the VR is distant from reality. The items are grouped into five dimensions: (1) *the sense of physical space*: the extent to which the user perceives themselves as physically present in the virtual environment, (2) *the engagement*: the extent to which the user perceives the content offered by the virtual environment, (3) *ecological appropriateness*: the level of realism and naturalness of the virtual environment and (4) *negative effects*: disruptive effects on the physical plane, such as nausea and eye discomfort that users may experience when immersed in the virtual environment, referring to four categories. Lastly, participants answered four open questions designed to *measure their satisfaction with the VR intervention*. Specifically, one researcher explored participants' satisfaction in reference to bodily and emotional awareness during and after VR, as follows: (1) 'Do you think it can be a useful experience to improve body awareness and decrease the sense of discomfort related to specific bodily parts after breast cancer?' (2) 'How do you feel now? And during the experience with VR?' (3) 'Does anything change after the VR experience in terms of thoughts and opinions?' And (4) 'in your opinion, what elements

facilitated or hindered your emotional awareness?' Answers were audio-recorded and transcribed by researchers.

3 | DATA ANALYSIS

Descriptive analyses were carried out for the entire sample of participants. Given the small sample size, to test differences before and after the VR session, nonparametric tests were performed on the self-reported questionnaires. The Wilcoxon signed-rank test was used to assess the paired difference before and after the VR experience in the valence, arousal/intensity and dominance of emotions experienced by participants in the SAM. The Wilcoxon signed-rank test was also used to assess differences in the perceived unpleasant sensations in the hands, feet and breasts, which were reported by participants through the VAS before and after the VR session. Similarly, the paired differences before and after the VR session were explored in relation to the level of state anxiety and the dimensions related to interoceptive aspects of body awareness. Lastly, the difference in interoceptive awareness was assessed through the Wilcoxon signed-rank test.

In addition, to assess the participants' experiences, a preliminary qualitative analysis regarding satisfaction with the VR intervention was conducted.

4 | RESULTS

The mean scores of the CWS highlighted a medium-to-high level of concern about cancer ($M=18.08$; $SD=4.92$) (Chirico et al., 2022). During the VR experience, participants perceived a good level of engagement in the virtual environment (*Engagement*: $M=49.31$, $SD=7.23$, range=37–62), which was perceived as quite realistic (*Ecological Appropriateness*: $M=15.38$, $SD=5.24$, range=5–25). Women reported a relatively low level of discomfort in the virtual environment (*Negative effects*: $M=8.15$, $SD=2.41$, range=6–12) and perceived themselves as physically present in the virtual environment (*Physical Space*: $M=55.62$, $SD=14.26$, range=24–79).

The Wilcoxon signed-rank test was used to explore the unpleasant bodily experiences before and after the VR session. As detailed in Table 1, participants reported a statistically significant decrease in their level of unpleasant sensations in their hands ($z=-2.028$, $p<.05$) and breasts ($z=-2.758$, $p<.01$). No statistically significant results emerged on the perceived sensations related to the feet ($z=-1.859$, $p=.063$), although scores decreased from the baseline after the virtual stimulation.

Similarly, the Wilcoxon signed-rank test was used to assess the emotional experiences of women involved in the study before and after the VR experience. Participants reported an increase in the pleasantness of their emotional status after the virtual immersion in the scenario ($z=-2.484$, $p<.05$), but the dominance and arousal/intensity of emotions did not change significantly over time.

TABLE 1 Results obtained before and after the VR stimulation.

	Pre		Post		z	p
	M	SD	M	SD		
VAS						
Hand	33.09	37.71	18.33	30.44	-2.028	.043
Feet	20.77	28.37	12.28	16.84	-1.859	.063
Breasts	43.23	26.53	28.33	22.23	-2.758	.006
SAM						
Valence	6.54	1.33	7.38	1.45	-2.484	.013
Arousal/intensity	4.00	1.91	4.85	2.67	-1.395	.163
Dominance	6.39	1.85	6.54	2.29	-0.853	.394
STAI						
State	39.85	9.33	33.83	4.57	-2.274	.023
MAIA						
Noticing	3.06	3.88	2.93	.90	-0.595	.552
Not distracting	1.79	.94	1.97	.81	-1.031	.302
Not worrying	2.46	1.14	2.56	.92	-0.206	.837
Attention regulation	2.36	.54	2.37	.66	-0.119	.906
Emotional	3.75	1.06	3.57	.91	-0.810	.418
Self-regulation	2.17	.83	2.08	.78	-0.410	.682
Body listening	2.31	1.10	2.49	.98	-0.960	.337
Trusting	2.88	.86	2.59	1.15	-1.286	.198

Abbreviations: MAIA, Multidimensional Assessment of Interoceptive Awareness; SAM, Self-Assessment Manikin; STAI, State-Trait Anxiety Inventory; VAS, Visual Analogue Scale.

A significant difference also emerged from the analyses conducted on the changes in the level of state anxiety of participants, showing that women involved in the study tended to feel less anxious after the VR stimulation ($z = -2.274$, $p < .05$), highlighting a possible positive impact of the virtual intervention on the levels of anxiety perceived by participants. Lastly, data highlighted that the virtual stimulus did not significantly affect the interoceptive aspects of body awareness.

Regarding the participants' *satisfaction with the VR intervention*, data suggested less discomfort of women during the experiment. Moreover, a high level of safety and lack of judgement have been highlighted. For example, participants stated: 'I felt a reduced discomfort during VR, really a lot. Although the red increased a sense of oppression, the white let me breathe again. I felt safe during this experience, I relied on this experience'; 'During VR, I perceived pleasant feelings...I was there warm, relaxed, comfortable... therefore it was pleasant' and 'I was very calm...VR created inner calm, I was rushing from work and I calmed down'. Furthermore, participants reported some qualitative changes before and after the VR intervention. In particular, some women evidenced a high level of concentration and bodily awareness after VR, as in the following excerpts: 'VR allowed me to focus on emotional perception. It can give important information to increase the awareness of one's body, promoting abilities to listen to inner sensations, even if they are not so pleasant to listen to' and 'After VR, I am a little more focused on myself and my sensations..... I am calmer..... I argue that the awareness of changes can be very helpful'.

5 | DISCUSSION

The present study aimed to assess the impact of VR on interoception in women with a breast cancer diagnosis. Oncological treatments lead to physical and emotional issues, resulting in a continuous perception of fatigue as well as negative emotions. Helping women to explore their psychological functioning, perceptions and feelings (i.e. self-curiosity; Aschieri & Durosini, 2015; Aschieri et al., 2016, 2020), and manage and regulate their emotions (i.e. emotional intelligence; Durosini et al., 2021) could help the promotion of their quality of life (Durosini et al., 2022). VR, as a tool to promote emotion regulation and body awareness, can help women with a cancer diagnosis to address bodily sensations and manage their inner emotions (Serino et al., 2016; So et al., 2022). VR can indeed extend the sense of self and corporeal awareness beyond the boundaries of the physical body (Kljajevic & Kljajevic, 2021). In particular, the present study involved three bodily parts: the breasts, the arms and the legs.

Interestingly, participants reported fewer unpleasant sensations after the VR intervention. Specifically, negative sensations related to hands and breasts decreased significantly. In line with the literature, increasing bodily awareness can favour emotion regulation thanks to the possibility to recognise and manage inner sensations (Herbert & Pollatos, 2012). Women who deal with breast cancer onset and its related treatments tend to be afraid of bodily sensations due to the fear of cancer recurrence; thus,

the perception of internal states can even be experienced as a dangerous event. Women tend to avoid interoceptive sensations, which are often associated with negative emotions and checking behaviours (McGinty et al., 2016). Promoting an effective bodily awareness may interplay between internal and external sensations in order to foster body belongingness, decreasing emotions of fear and anxiety (Raimo et al., 2021). In accordance with these results, participants showed improvements in positive emotions after the VR intervention. Specifically, emotional pleasantness increased significantly. As mentioned above, VR can increase a stable sense of bodily awareness, promoting the perception of positive emotions (Keenaghan, 2021). Regarding emotions, state anxiety significantly decreased after the intervention. Generally, anxiety is characterised by biases and cognitive distortions, increasing threatening situations that are not managed appropriately (Kaczurkin & Foa, 2015). VR allows for exposure therapy to change memories related to fearful stimuli, promoting novel information that allows the emotional regulation and modification of distorted interpretations (Maples-Keller et al., 2017). In this way, emotion regulation plays a fundamental role in anxiety symptoms (Sendzik et al., 2017). The possibility of meta-knowledge about emotional states and experiences is characterised by attentional and interpretive processes that favour ongoing monitoring and differentiating of emotions (Rieffe & De Rooij, 2012). We argue that a better awareness of inner states allows for managing and regulating emotional issues, addressing anxiety that can be a dysfunctional emotion. Finally, women included in this study had a medium-to-high level of fear of cancer recurrence, according to Chirico et al. (2022). As reported in the literature, women with breast cancer still experience a high fear of cancer recurrence 10 years after diagnosis (Tran et al., 2022). In particular, Yang et al. (2022) evidenced that anxiety and excessive worries, which are often present in women who have received a breast cancer diagnosis, can increase fear of cancer recurrence over time. Thus, the authors suggested implementing interventions aimed at alleviating uncontrollable worries and fostering the perception of personal control over feelings and emotions. In line with this, a systematic review by Lyu et al. (2022) recommended psychological interventions to decrease the fear of cancer recurrence after a breast cancer diagnosis, in particular, mindfulness and acceptance therapy-based programmes.

Finally, we explored the overall participants' satisfaction by including some open questions. The positive responses from participants who reported reduced discomfort, a heightened sense of safety and a lack of judgement during the VR experience emphasise the potential benefits of this intervention. Accordingly, studies have demonstrated the increasing evidence of VR as a tool to enhance emotion regulation and cognitive restructuring, even some years after a traumatic event (Colombo et al., 2021). For example, the programme 'Engaging Media for Mental Health Application' is a flexible VR system in which people can shape and customise their virtual environment to generate personally significant reactions for the treatment of post-traumatic stress

disorders. Specifically, VR has the ability to evoke traumatic situations through the use of symbols; thus, people can recognise and manage the meaning and interpretation of the traumatic event (Baños et al., 2011; Guillén et al., 2018).

6 | CONCLUSIONS

Our study proposes a VR intervention to address inner sensations in women who received a breast cancer diagnosis in the past. Findings are especially interesting because evidence regarding the implementation of VR in the field of oncology is scarce in the literature; on the contrary, there are many studies regarding the involvement of VR interventions to address eating and anxiety disorders, for example (De Carvalho et al., 2017; Eijlers et al., 2019). We have proposed an alternative implementation of VR aimed at addressing interoception and their related emotions, the fear of cancer recurrence especially; however, the absence of measures of interoception as used in other studies can be considered a limitation (Ainley et al., 2013). Future studies may employ other measurement tools to analyse the impact of VR on variations in interoception. Additionally, the small sample size that may underestimate the results can be considered as another limitation. In line with this, it could be interesting to better understand whether individual factors (e.g. age and type of cancer) play a role in the relationship of VR and interoception. Similarly, personality traits have not been considered. Additional research could measure how personality traits and mood states may affect the effectiveness of VR on the promotion of inner sensation awareness. Lastly, it would be interesting to assess the impact of a VR intervention in which there are other people involved, starting from the relevant role of social connection in cancer (Durosini, Triberti, Ongaro, & Pravettoni, 2021). In future studies, we will also focus on an in-depth qualitative analysis of participants' thoughts about their bodies after cancer. Exploring these aspects before and after the VR intervention will allow a better understanding of the possible changes in participants' thoughts about their physical sensations and emotions. Moreover, the assessment of how the intervention could help self-reported improvements could help develop an understanding of the psychological processes underlining the participants' emotional changes.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

ETHICAL APPROVAL

The Ethics Committee of University of Milan approved the study (N2/23; 2022, 18th January). This study followed the Declaration of Helsinki.

PATIENT CONSENT STATEMENT

All the participants provided written informed consent to participate in the study.

CONSENT FOR PUBLICATION

All the participants provided written consent to publish the present findings.

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