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# A questionable version of the Post-Traumatic growth inventory-Short form in women diagnosed with breast cancer

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1 **A questionable version of the Post-Traumatic Growth Inventory – Short Form**  
2 **in women diagnosed with breast cancer**

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19

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21

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2 enrolment through a dedicated online information page.

3  
4 **Authors contributions:** *Bertrand Porro*: statistical analysis, interpretation of data, drafting the  
5 article and the final approve of the version to be submitted. *Guillaume Broc*: revising the article  
6 critically for important intellectual content and the final approve of the version to be submitted.  
7 *Fanny Baguet-Marin*: conception and design of the study, acquisition of data. *Florence*  
8 *Cousson-Gélie*: conception and design of the study, revising the article critically for important  
9 intellectual content and the final approve of the version to be submitted.

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1 **A questionable version of the Post-Traumatic Growth Inventory – Short Form in women**  
2 **diagnosed with breast cancer**

3 **Abstract**

4 **Objectives:** Because the full version of the Post Traumatic Growth Inventory was considered too  
5 long, a short English version (ten items/five factors) was initially proposed in the literature  
6 (PTGI-SF). Thereafter another short Italian version (ten items/five factors) and a unidimensional  
7 English version (11 items) were proposed. This study aimed at evaluating which of these three  
8 versions of the PTGI-SF could be best adapted to women diagnosed with breast cancer.

9 **Design:** Cross-sectional and psychometrics study.

10 **Methods:** A total of 239 breast cancer patients or survivors were included in the study. To assess  
11 all items related to the different PTGI-SF candidate versions; the full-length PTGI has been used  
12 to measure PTG. A set of psychometric analyses, including a confirmatory factor analysis,  
13 composite reliability and construct validity has been performed.

14 **Results:** The English unidimensional version did not fit the data ( $SB\text{-}Chi^2 = 184.47$ ,  $df = 42$ ,  $p <$   
15  $0.001$ ;  $SB\text{-}RMSEA = 0.119$ ;  $SB\text{-}CFI = 0.814$ ;  $SB\text{-}TLI = 0.757$ ;  $SRMR = 0.083$ ). Both the English  
16 ( $SB\text{-}Chi^2 = 61.40$ ,  $df = 25$ ,  $p < .001$ ;  $SB\text{-}RMSEA = 0.078$ ;  $SB\text{-}CFI = 0.948$ ;  $SB\text{-}TLI = 0.907$ ;  
17  $SRMR = 0.048$ ) and Italian ( $SB\text{-}Chi^2 = 26.52$ ,  $df = 25$ ,  $p > 0.05$ ;  $SB\text{-}RMSEA = 0.016$ ;  $SB\text{-}CFI =$   
18  $0.998$ ;  $SB\text{-}TLI = 0.996$ ;  $SRMR = 0.026$ ) versions (ten items/five factors respectively) showed  
19 satisfactory psychometric results.

20 **Conclusion:** Further investigations are thus required to identify which of these two versions of  
21 the PTGI-SF is the most appropriate for women diagnosed with breast cancer.

22 **Keywords:** Breast Cancer; Post Traumatic Growth Inventory; Short-Form; Psychometrics;  
23 Confirmatory Factor Analysis

1 **A questionable version of the Post-Traumatic Growth Inventory – Short Form in women**  
2 **diagnosed with breast cancer**

3  
4 **Introduction**

5 Breast cancer is the most common cancer in women worldwide (Bray et al., 2018).  
6 Thanks to advances in cancer treatments and increasingly effective prevention and/or screening  
7 campaigns, a worldwide decrease in breast cancer-associated mortality has been observed in  
8 recent decades (Bray et al., 2018; Shapiro, 2018). The disease is thus inscribed in the life history  
9 of breast cancer survivors which, for some of them, may have a long-term deleterious impact –  
10 from diagnosis to several years after– on their overall quality of life and particularly on their  
11 psychological well-being (Brandão et al., 2017). However, an increasing number of studies have  
12 shown that many breast cancer patients and survivors may report both low psychological well-  
13 being and positive psychological changes –conceptualized as Post-Traumatic Growth (PTG)–  
14 during and after treatments (Bahrami et al., 2015; Bellizzi et al., 2010; Danhauer et al., 2013;  
15 Kolokotroni et al., 2014; Lelorain et al., 2010; Wang et al., 2014).

16 According to Tedeschi and Calhoun (1996), people experiencing PTG after a stressful life  
17 event may report deeper social relationships, develop some form of personal strength or  
18 spirituality, perceive new life opportunities, and/or appreciate their lives more. As it has emerged  
19 in scientific literature, PTG has been considered a worthwhile perspective to be integrated into  
20 clinical practice (Zoellner & Maercker, 2006). Patients experiencing trauma, such as cancer,  
21 often seek to make sense of the occurrence of this trauma in their lives. Initial explanations are  
22 often self-deprecating, whereas the PTG may offer new perspectives that are more positive in  
23 terms of growth (Zoellner & Maercker, 2006). Several questionnaires are currently used to assess  
24 PTG in cancer patients, such as the Stress-Related Growth Scale (Park et al., 1996), the Changes

1 in Outlook Questionnaire (Joseph et al., 2006), the Perceived Benefit Scales (McMillen & Fisher,  
2 1998), and the Post Traumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996).

3 The PTGI (Tedeschi & Calhoun, 1996) is the most commonly-used questionnaire to  
4 assess PTG in cancer patients and survivors (Casellas-Grau et al., 2017; Harding et al., 2014;  
5 Kolokotroni et al., 2014; Liu et al., 2020; Zhai et al., 2019). The initial PTGI integrates 21 items  
6 in a five-factor model (relating to others, new possibilities, personal strength, spiritual change and  
7 appreciation of life) displaying excellent internal consistency and test-retest reliability (Tedeschi  
8 & Calhoun, 1996). The PTGI factor structure in patients diagnosed with cancer has been the  
9 subject of much debate in scientific literature (Brunet et al., 2010; Costa Requena & Gil  
10 Moncayo, 2012; Heidarzadeh et al., 2017; Ho et al., 2013; Liu et al., 2015; Ramos et al., 2016;  
11 Wang et al., 2018). Finally, it was the study conducted by Brunet et al. (2010) that provided  
12 strong evidence that the PTGI reliably assessed five related PTG dimensions.

13 Although the initial PTGI version is a reliable PTG measure (Brunet et al., 2010; Tedeschi  
14 & Calhoun, 1996), there are arguments for validating a shorter version of the PTGI in patients  
15 diagnosed with cancer: (i) chemotherapy treatments induce long-term cognitive fatigue (Zeng et  
16 al., 2020) requiring that psychometric tools used in research and/or clinical practice be as short as  
17 possible to reduce the concentration time required to complete the questionnaire (Morgado et al.,  
18 2017); (ii) the use of a short version of the PTGI in clinical practice can allow for longer  
19 discussion between the practitioner and the patient; (iii) research protocols, which are becoming  
20 increasingly long and complex due to the desire for a multidimensional assessment of health  
21 problems, require the use of increasingly short tools (Morgado et al., 2017).

22 Cann et al. (2010) developed a short form of the Post-Traumatic Growth Inventory  
23 (PTGI-SF) integrating 10 items divided into groups of two items for each of the five initial PTG  
24 domains (relating to others, new possibilities, personal strength, spiritual change and appreciation

1 of life). Using the initial PTGI, the 10 items included in the PTGI-SF have been obtained by  
2 performing a first confirmatory factor analysis, in 1,351 adults who have experienced a traumatic  
3 event, aiming to identify the items that scored most highly on each factor (Cann et al., 2010). A  
4 second confirmatory factor analysis, conducted with 186 university students who completed only  
5 the final PTGI-SF, concluded that the original five-factor solution was the most appropriate, with  
6 excellent psychometric properties and good internal consistency (Cann et al., 2010).

### 7 ***The PTGI-SF: a literature review***

8 Appendix A refers a literature review aiming to identify studies proposing to validate the  
9 PTGI-SF. Figure S1 presents the flow chart and Table S1 provides a summary of the fit and  
10 reliability indices of the different validations identified in the literature.

11 The PTGI-SF has been validated in American veterans from the Iraq war (Kaler et al.,  
12 2011), in Portuguese divorced adults (Lamela et al., 2014), in Spanish university students (Castro  
13 et al., 2015), in French-Canadian caregivers (Cadell et al., 2015), in Chilean adults who  
14 experienced an earthquake (García & Włodarczyk, 2016), in Palestinian professional helpers  
15 (Veronese & Pepe, 2019), and once in 195 Malaysian cancer patients which resulted in a five-  
16 factor model (Abdullah et al., 2017). Two modified versions of the PTGI-SF have also been  
17 proposed –one of these by Prati & Pietrantonì (2014), the second by Kaur et al. (2017)– but have  
18 not been assessed in patients diagnosed with cancer.

19 First, Prati & Pietrantonì (2014) have proposed a 10-item and five-factor version of the PTGI-SF.

20 The main difference is the replacement of three items<sup>1 2 3</sup> compared to the original PTGI-SF

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<sup>1</sup> New Possibilities: item 14 “*New opportunities are available which wouldn’t have been otherwise*” (Prati and Pietrantonì, 2014); instead, item 7 “*I established a new path for my life*” (Cann et al., 2010).

<sup>2</sup> Personal Strength: item 4 “*A feeling of self-reliance*” (Prati and Pietrantonì, 2014); instead, item 19 “*I discovered that I’m stronger than I thought I was*” (Cann et al., 2010).



1 version. Using the same items' identification method as Cann et al. (2010), the replacement of  
2 these three items was based on three specific criteria: (i) the selected items had to be the two from  
3 each dimension that scored highest in their respective dimensions; (ii) the selected items had to  
4 be non-redundant; and (iii) the selected items had to be clinically representative of their own  
5 dimension (Prati & Pietrantonio, 2014). This version showed excellent psychometric qualities in  
6 1,244 Italian adults who have experienced a traumatic event (Prati & Pietrantonio, 2014).  
7 Second, Kaur et al. (2017) have proposed an 11-item and unidimensional version of the PTGI-SF  
8 by adding "*Having compassion for others*". After performing a confirmatory factor analysis in  
9 67,922 adults who have experienced a traumatic event, this version fitted well (Kaur et al., 2017).  
10 Both of these modified versions were obtained respectively from large samples (Kaur et al.,  
11 2017; Prati & Pietrantonio, 2014), which makes them as relevant as the version proposed by Cann  
12 et al. (2010). Studies aimed at validating the PTGI-SF therefore must consider these two  
13 candidate proposals to identify the best PTGI-SF version suited to cancer survivors.

#### 14 ***Objective of the study***

15 The objective of this study was to evaluate which of the original version of the PTGI-SF  
16 (Cann et al., 2010) or the two modified versions of the PTGI-SF (Kaur et al., 2017; Prati &  
17 Pietrantonio, 2014) could be best adapted to a sample of women diagnosed with breast cancer.

#### 18 **Methods**

19 This study was approved on 18<sup>th</sup> June 2014 by the *National Health Research Information*  
20 *Processing Advisory Committee* (CCTIRS: registered number 14.358), and on 16<sup>th</sup> July 2014 by  
21 the *National Commission for Information and Freedoms* (CNIL: registered number

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<sup>3</sup> Appreciation of Life: Item 13 "*Appreciating each day*" (Prati and Pietrantonio, 2014); instead, item 1 "*My priorities about what is important in life*" (Cann et al., 2010).

1 ycE10929299). Written informed consent was obtained from all participants before enrolment  
2 through a dedicated online information page.

### 3 ***Participants and Procedure***

4 Patients were eligible for inclusion if (i) they had been diagnosed with breast cancer and if  
5 they had started at least one breast cancer treatment; (ii) they were over 18 years old at the time  
6 of their cancer diagnosis; (iii) and they agreed to participate. Patients with more than one breast  
7 cancer diagnosis or patients in recurrence, as well as those who had not started breast cancer  
8 treatment and women with a psychiatric history were not eligible for the study.

9 From October 2015 to September 2016, online informed consent and self-administered  
10 research protocol were set up on the *Seintinelles* platform ([www.seintinelles.com](http://www.seintinelles.com)). *Seintinelles* is  
11 a French national association that includes cancer patients, cancer survivors and/or other people  
12 (e.g. caregivers) wishing to help cancer research (Pannard et al., 2020).

### 13 ***Measure***

14 Sociodemographic (age, education, marital status, number of children, employment status)  
15 and medical data (age at diagnosis, date of diagnosis, adjuvant therapy and completion of  
16 therapy) were recorded.

17 The three short versions of the PTGI-SF evaluated in this study (Cann et al., 2010; Kaur et  
18 al., 2017; Prati & Pietrantonio, 2014) are derived from the full-length PTGI-21 (Tedeschi &  
19 Calhoun, 1996). The PTGI-21 was translated into French by Lelorain (2009) and is commonly  
20 used to assess PTG in France (Bourdon et al., 2019; Lelorain et al., 2010; Porro et al., 2020). To  
21 avoid redundant items, the participants of this study completed only the full-length PTGI-21  
22 (Tedeschi & Calhoun, 1996). Patients responded to questions that asked to what extent they had  
23 been experiencing positive life changes because of the breast cancer experience. The PTGI  
24 comprises 21 items, with response choices ranging from 0 to 5 (0 = I did not experience this

1 change at all; 5 = I have definitely experienced this change). The PTGI measures five areas of  
2 growth, such as relating to others (seven items,  $\alpha = 0.86$ ), new possibilities (five items,  $\alpha = 0.86$ ),  
3 personal strength (four items,  $\alpha = 0.77$ ), spiritual change (two items,  $\alpha = 0.58$ ) and appreciation  
4 of life (three items,  $\alpha = 0.85$ ). From these 21 items constituting the full-length PTGI-21, we  
5 selected the ten items from the PTGI-SF recommended by both Cann et al. (2010) and Prati &  
6 Pietrantonio (2014), as well as the eleven items from the PTGI-SF recommended by Kaur et al.  
7 (2017).

### 8 *Statistical analysis*

9 Statistical analysis was performed with Stata® software version 17.0 Descriptive analyses  
10 of the sample were carried out using percentages for categorical data and means completed with  
11 standard deviations (SD) for continuous data. Psychometric properties were assessed through the  
12 following set of analyses.

13 *Confirmatory Factor Analysis.* The three versions of the PTGI-SF (Cann et al., 2010;  
14 Kaur et al., 2017; Prati & Pietrantonio, 2014) were subjected to a confirmatory factor analysis  
15 using Structural Equation Modeling. The tested models are available in Appendix B and the  
16 variance-co-variance matrices in Appendix C. Due to the lack of multivariate normality –assessed  
17 with the Doornik-Hansen test– for Model A (Cann et al., 2010) ( $\text{Chi}^2 = 437.01$ ,  $\text{df} = 20$ ,  $p <$   
18  $.001$ ), Model B (Prati & Pietrantonio, 2014) ( $\text{Chi}^2 = 391.07$ ,  $\text{df} = 20$ ,  $p <$   $.001$ ) and Model C (Kaur  
19 et al., 2017) ( $\text{Chi}^2 = 448.27$ ,  $\text{df} = 21$ ,  $p <$   $.001$ ), the robust Maximum Likelihood method with  
20 Satorra-Bentler estimation was performed (Chou et al., 1991; Satorra & Bentler, 1994). Four  
21 model fit indices were adopted to assess the goodness-of-fit of the models: the Satorra-Bentler  
22 Comparative Fit Index (SB-CFI), the Satorra-Bentler Tucker-Lewis Index (SB-TLI), the Satorra-  
23 Bentler Root Mean Square Error of Approximation (SB-RMSEA) and the Standardized Root

1 Mean Squared Residual (SRMR). Overall fit for the indices was evaluated using these criteria  
2 (Brown, 2015; Hu & Bentler, 1999): SB-CFI and SB-TLI acceptable if  $\geq 0.90$  and good if  $\geq 0.95$ ;  
3 SB-RMSEA acceptable if  $\leq 0.08$  and good if  $\leq 0.06$ ; SRMR good if  $\leq 0.08$ . Since  $\text{Chi}^2$  values are  
4 dependent on sample size (Marsh & Balla, 1994), they were not taken into account for the model  
5 fit but were specified by convention.

6 Selecting the best version of the PTGI-SF was not only limited to the model presenting  
7 the best fit indices (Farrell & Rudd, 2009). Models that did not fit were discarded, and when they  
8 did fit, the decision was based on a pattern of results including composite reliability, and  
9 construct validity (convergent validity and discriminant validity).

10 *Composite reliability.* Raykov's Reliability Coefficient (RRC) was used for factors from a  
11 confirmatory factor analysis, a measure which is commonly seen as more accurate than  
12 Cronbach's alpha, which is computed based on the assumption of Tau-equivalent measures  
13 (Raykov, 1997, 1998, 2001). RRC was good if  $\geq 0.700$  and acceptable if  $\geq 0.600$  (Raykov, 1997,  
14 1998, 2001). In this study, RRC was computed using the Stata<sup>®</sup> module developed by  
15 Mehmetoglu (2015a), namely the *RELICOE*F module.

16 *Construct validity.* Campbell & Fiske (1959) proposed two aspects to assess the construct  
17 validity of a questionnaire: convergent validity and discriminant validity. In a Confirmatory  
18 Factor Analysis, convergent and discriminant validity examine respectively the extent to which  
19 measures of a latent variable shared their variance and how they are different from others  
20 (Campbell & Fiske, 1959; Fornell & Larcker, 1981). Convergent validity is commonly referred to  
21 as *Average Variance Extracted* (AVE) (Fornell & Larcker, 1981). AVE was considered good if  $\geq$   
22 0.500 but if just under 0.500, Fornell & Larcker (1981) have stated that the RRC really needs to  
23 be higher than 0.600. AVE was computed using the Stata<sup>®</sup> module developed by Mehmetoglu

1 (2015b), namely the *CONDISC* module. Discriminant validity was assessed using the *CONDISC*  
2 module (Mehmetoglu, 2015b). Squared Correlation (SC) was among the latent variables that  
3 were computed. If AVE values  $\geq$  SC values, there was no problem with discriminant validity  
4 (Henseler et al., 2015).

## 5 **Results**

### 6 *Study population*

7 After sending the online informed consent and research protocol, 337 questionnaires were  
8 returned, of which 278 (82.49%) participants were eligible for the study. Finally, 239 women  
9 diagnosed with breast cancer met the inclusion criteria (Figure 1). At diagnosis, the mean age was  
10 44.91 years old (SD = 9.37). The mean age was 47.13 years old (SD = 9.71) and mean time since  
11 diagnosis was 26.66 months (SD = 17.10). Most participants were educated to university level (n  
12 = 158; 66.1%). Descriptive characteristics of the sample are reported in Table 1.

13 [Please insert Figure 1 around here]

14 [Please insert Table 1 around here]

### 15 *Confirmatory factor analysis*

16 Model A (Cann et al., 2010) yielded to acceptable fit indices (SB- $\chi^2 = 61.40$ ,  $df = 25$ ,  $p$   
17  $< .001$ ; SB-RMSEA = 0.078; SB-CFI = 0.948; SB-TLI = 0.907; SRMR = 0.048). All the items  
18 scored significantly on their expected factor, and inter-factor co-variances were significant, from  
19 0.38 to 0.75 (Table 2). Furthermore, the best fit indices were observed for Model B (Prati &  
20 Pietrantoni, 2014) (SB- $\chi^2 = 26.52$ ,  $df = 25$ ,  $p > 0.05$ ; SB-RMSEA = 0.016; SB-CFI = 0.998;  
21 SB-TLI = 0.996; SRMR = 0.026). All items scored significantly on their expected factor and the  
22 co-variances between the factors were significant, from 0.44 to 0.88 (Table 2). Conversely, fit  
23 indices for Model C (Kaur et al., 2017) were poor (SB- $\chi^2 = 184.47$ ,  $df = 42$ ,  $p < 0.001$ ; SB-

1 RMSEA = 0.119; SB-CFI = 0.814; SB-TLI = 0.757; SRMR = 0.083). Consequently, we decided  
2 to definitively reject Model C at this stage.

3 [Please insert Table 2 around here]

4 Table 3 provides a summary of the validity and reliability indicators of Model A (Cann et al.,  
5 2010) and Model B (Prati & Pietrantonio, 2014).

6 [Please insert Table 3 around here]

7 ***Model A (Cann et al., 2010) – Ten items / five factors***

8 *Composite reliability.* Model A presented the best RRC, which was good for “Total  
9 Score” and for three factors (“New Possibilities”, “Appreciation of Life” and “Spiritual  
10 Change”), and acceptable for two factors (“Relating to Others” and “Personal Strength”) (Table  
11 3).

12 *Construct validity.* Convergent validity was acceptable for all subscales with the  
13 exception of one (“Personal Strength) in which the AVE values were close to the 0.500 threshold  
14 (AVE = 0.494) (Table 3). Due to its RRC (“Personal Strength” RRC = 0.656), AVE could,  
15 however be considered acceptable (Fornell & Larcker, 1981). Discriminant validity was not  
16 supported for the following dimensions (Table 3, Table 4): New Possibilities (AVE = 0.610 <  
17  $SC_{\text{Appreciation of Life}} = 0.739$ ) and Personal Strength (AVE = 0.494 <  $SC_{\text{New Possibilities}} = 0.567$ ).

18 The final questionnaire is available in Appendix D.

19 [Please insert Table 4 around here]

20 ***Model B (Prati & Pietrantonio, 2014) – Ten items / five factors***

21 *Composite reliability.* RRC was good for only two dimensions (“Personal Strength” and  
22 “Appreciation of Life”) and for “Total Score”. RRC for the “Relating to Others”, “New  
23 Possibilities” and “Spiritual Changes” dimensions was acceptable (Table 3).

1           *Construct validity.* All AVE values were acceptable but discriminant validity was not  
2 supported for the following dimensions (Table 3, Table 4): New Possibilities (AVE = 0.575 <  
3  $SC_{\text{Personal Strength}} = 0.608$  and AVE = 0.575 <  $SC_{\text{Appreciation of Life}} = 0.771$ ), Personal Strength (AVE =  
4 0.543 <  $SC_{\text{Appreciation of Life}} = 0.600$  and AVE = 0.543 <  $SC_{\text{New Possibilities}} = 0.608$ ), and Appreciation  
5 of Life (AVE = 0.670 <  $SC_{\text{New Possibilities}} = 0.771$ ).

6           The final questionnaire is available in Appendix E.

## 7 **Discussion**

8           This study aimed to identify which of the three versions of the PTGI-SF, available in the  
9 scientific literature (Cann et al., 2010; Kaur et al., 2017; Prati & Pietrantonio, 2014) was best  
10 suited to a sample of breast cancer patients.

11           The one-factor and 11-item version (Kaur et al., 2017) was discarded very early in the  
12 analysis process. The unidimensional proposal has been rejected in several studies, both in the  
13 long and short versions of the PTGI, justifying the PTG perceived by patients diagnosed with  
14 cancer as a multidimensional concept (Abdullah et al., 2017; Brunet et al., 2010; Hirooka et al.,  
15 2018; Wang et al., 2018). In this study the versions of the PTGI-SF proposed by Cann et al.  
16 (2010) and Prati & Pietrantonio (2014) were carefully compared. In both versions, there is a  
17 discriminant validity problem that includes the following dimensions: “new possibilities”,  
18 “personal strength” and “appreciation of life”. Tedeschi & Calhoun (1996) initially defined the  
19 PTG in three dimensions as follows: “perceived changes in self”, “a changed sense of  
20 relationships with others” and “a changed life philosophy”. The combination of “new  
21 possibilities”, “personal strength” and “appreciation of life” could thus constitute a single  
22 dimension: “perceived changes in self”. These results further fuel the debate about the factor  
23 structure of the questionnaire’s full-length version (Brunet et al., 2010; Costa Requena & Gil  
24 Moncayo, 2012; Heidarzadeh et al., 2017; Ho et al., 2013; Liu et al., 2015; Ramos et al., 2016;

1 Wang et al., 2018). A three-dimensional version of the PTGI-SF would, however, allow for a  
2 scale with at least one dimension with more than two items. The results of this study indicate that  
3 it is important, however, to identify the correct version of the PTGI-SF, including items relevant  
4 and specific to women diagnosed with breast cancer.

5         The main difference between these two versions is the replacement of the following three  
6 items: items 14 (“*New opportunities are available which wouldn’t have been otherwise*”), 4 (“*A*  
7 *feeling of self-reliance*”), and 13 (“*Appreciating each day*”) (Prati & Pietrantonio, 2014) instead of  
8 items 7 (“*I established a new path for my life*”), 19 (“*I discovered that I’m stronger than I*  
9 *thought I was*”), and 1 (“*My priorities about what is important in life*”) (Cann et al., 2010),  
10 respectively. Both versions showed satisfactory psychometric properties, making it impossible to  
11 conclude which version of the PTGI-SF is best to use for women diagnosed with breast cancer.  
12 Considering only the confirmatory factor analysis, the choice would lean more towards the Italian  
13 version proposed by Prati & Pietrantonio (2014) rather than Cann et al. (2010). This would be all  
14 the more justified since the Italian version proposed by Prati & Pietrantonio (2014) seems  
15 culturally closer to France, as a European country. On the other hand, until now, this version had  
16 never been tested on patients diagnosed with cancer. Conversely, when considering the results of  
17 the convergent validity and the composite reliability, the choice would lean more towards the  
18 American version proposed by Cann et al. (2010), rather than Prati & Pietrantonio (2014). This  
19 selection might corroborate the results of the Malay study performed by Abdullah et al. (2017) on  
20 195 patients diagnosed with cancer. In addition, given the nature of the divergent items between  
21 the two versions, selecting the American version (Cann et al., 2010) would be justified by the  
22 verbatims generally found in qualitative studies (Kampman et al., 2015; Mackenzie, 2014;  
23 Mehrabi et al., 2015; Rashidi et al., 2021; Zhai et al., 2019).



1           The difficulty in reaching conclusions raises the question of how to adapt the various  
2 short scales proposed in the scientific literature to both the cross-cultural and the study population  
3 (International Test Commission, 2017). The problem is less noticeable when the goal is to  
4 validate a single short version of a questionnaire, whether it is derived from a previously adapted  
5 long version, or whether it has been culturally and/or populationally adapted. In this case, the  
6 analyses carried out on this version alone enable us to conclude whether it is a valid scale or not.  
7 When several short versions are competing, as in this study, the problem of face validity becomes  
8 more visible. If a long form of the questionnaire is available and has already been adapted, it still  
9 seems important to at least perform a preliminary step with representatives of the study  
10 population and experts in the field to select the most relevant short version to be evaluated within  
11 a larger sample (International Test Commission, 2017). Focus groups or consensus studies using  
12 questionnaires can be used, for example, to conduct such an evaluation (International Test  
13 Commission, 2017).

#### 14 ***Limitations and Strengths***

15           This study has some limitations, the main one being that participants were recruited  
16 through the *Seintinelles* platform, suggesting that breast cancer participants may be younger and  
17 have a higher level of education (Pannard et al., 2020). The self-reported mode does not facilitate  
18 the valid collection of technical data, particularly medical data, which are very complex for  
19 patients, such as the stage of cancer, which is not mentioned in this study, and which could show  
20 the representativeness of the sample in breast cancer patients. However, we were able to gather a  
21 sample of participants sufficient to carry out a set of analyses including a confirmatory factor  
22 analysis on a questionnaire comprising ten items. In addition, it would have been preferable for  
23 patients to complete each of the three versions of the PTGI-SF (Cann et al., 2010; Kaur et al.,  
24 2017; Prati & Pietrantonio, 2014). Completion of the long version of the PTGI-21 (Tedeschi &

1 Calhoun, 1996) avoided redundant items as well as possible changes in common item responses  
2 from one short version to another. As explained above, a preliminary study would have been  
3 useful to identify which version of the PTGI-SF should have been submitted to patients.

#### 4 ***Clinical implications and recommendations for future research***

5 Breast cancer patients are not always aware of their psychological progress, as the  
6 treatments are so demanding and anxiety-provoking. It is by asking them simple but precise  
7 questions that they finally manage to see the positive side of a journey that is still too often seen  
8 as negative. There is a balance between the positive and the negative, but it is necessary to  
9 support them in the right way so that they become aware of it (Zoellner & Maercker, 2006).  
10 There is a great clinical interest in validating a reliable and definitive version of the PTGI-SF. Its  
11 short length will facilitate discussion time with the patient whilst using a valid questionnaire  
12 targeting the precise questions to be asked. This study highlighted three versions of the PTGI-SF  
13 available in scientific literature (Cann et al., 2010; Kaur et al., 2017; Prati & Pietrantonio, 2014),  
14 two of which have nearly equivalent psychometric properties (Cann et al., 2010; Prati &  
15 Pietrantonio, 2014). Further investigations are required to identify which version of the PTGI-SF is  
16 ultimately the most appropriate for women diagnosed with breast cancer. Future studies will need  
17 to carefully observe the cross-cultural and population adaptation of each of these short versions  
18 before statistical evaluations can be made. These statistical evaluations should not be based solely  
19 on confirmatory factor analyses but also on a plurality of analyses that facilitate final decision  
20 making. Furthermore, this study only targeted patients diagnosed with breast cancer, but further  
21 investigations, including a test-retest reliability, can be carried out with patients with tumors in  
22 other areas. Finally, regarding the scientific literature, another research perspective consists in  
23 integrating a complementary dimension to the PTGI-SF, namely “*Physical Growth*” (Hefferon et  
24 al., 2009; Love & Sabiston, 2011).

## 1 **Conclusions**

2           The results of this study did not enable a conclusion as to which of the PTGI-SF versions  
3 proposed by Cann et al. (2010) and Prati & Pietrantonio (2014) is the most suitable for women  
4 diagnosed with breast cancer. These results are nevertheless encouraging for further work that  
5 will be undertaken to better understand positive life changes in women diagnosed with breast  
6 cancer.

## 7 **Conflicts of interest**

8 The authors have no conflict of interest to declare.

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13

1 Table 1. Descriptive analysis of the sample

<b>N = 239</b>	<b>n (%)</b>	<b>Mean (SD)</b>
Age at diagnosis	-	44.91 (9.37)
Age at the filling time	-	47.13 (9.71)
Education		
<i>≤ Primary school</i>	6 (2.5)	-
<i>Secondary school</i>	6 (2.5)	-
<i>High school</i>	69 (28.9)	-
<i>≥ University</i>	158 (66.1)	-
In an intimate relationship at the filling time	196 (82.0)	-
Number of children		-
0	27 (11.3)	-
1	37 (15.5)	-
2	120 (50.2)	-
3 or more	55 (23.0)	-
Employed at the filling time	172 (72.0)	-
Months since diagnosis	-	26.66 (17.10)
<i>≤ 12 months</i>	64 (27.6)	
<i>13 – 24 months</i>	50 (21.6)	
<i>25 – 36 months</i>	54 (23.3)	
<i>37 – 48 months</i>	35 (14.6)	
<i>≥ 49 months</i>	29 (12.5)	
Treatments		
<i>Chemotherapy</i>	186 (77.8)	-
<i>Radiation Therapy</i>	202 (84.5)	-
<i>Hormone Therapy</i>	152 (63.6)	-
Completed treatments	91 (38.1)	-

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Table 2. Factors loadings and covariances for Model A (Cann et al., 2010) and Model B (Prati & Pietrantonio, 2014)

Model A (Cann et al., 2010)						Model B (Prati & Pietrantonio, 2014)					
Dimensions / Items	1	2	3	4	5	Dimensions / Items	1	2	3	4	5
<b>Factor 1: Relating to Others</b>		<b>0.67***</b>	<b>0.58***</b>	<b>0.44***</b>	<b>0.38***</b>	<b>Factor 1: Relating to Others</b>		<b>0.67***</b>	<b>0.63***</b>	<b>0.48***</b>	<b>0.53***</b>
8. A sense of closeness with others	0.92					8. A sense of closeness with others	0.87				
20. I learned a great deal about how wonderful people are	0.53					20. I learned a great deal about how wonderful people are	0.57				
<b>Factor 2: New Possibilities</b>			<b>0.75***</b>	<b>0.59***</b>	<b>0.86***</b>	<b>Factor 2: New Possibilities</b>			<b>0.78***</b>	<b>0.57***</b>	<b>0.88***</b>
7. I established a new path for my life.		0.80				11. I'm able to do better things with my life		0.85			
11. I'm able to do better things with my life.		0.76				14. New opportunities are available which wouldn't have been otherwise		0.66			
<b>Factor 3: Personal strength</b>				<b>0.41***</b>	<b>0.64***</b>	<b>Factor 3: Personal strength</b>				<b>0.49***</b>	<b>0.77***</b>
10. Knowing I can handle difficulties			0.77			4. A feeling of self-reliance			0.74		
19. I discovered that I'm stronger than I thought I was			0.63			10. Knowing I can handle difficulties			0.73		
<b>Factor 4: Spiritual change</b>					<b>0.39***</b>	<b>Factor 4: Spiritual change</b>					<b>0.44***</b>
5. A better understanding of spiritual matters				0.98		5. A better understanding of spiritual matters				0.94	
18. I have stronger religious faith				0.42		18. I have stronger religious faith				0.43	
<b>Factor 5: Appreciation of life</b>						<b>Factor 5: Appreciation of life</b>					
1. My priorities about what is important in life					0.82	2. An appreciation for the value of my own life					0.79
2. An appreciation for the value of my own life					0.89	13. Appreciating each day					0.85

Notes. \*\*\*:  $p < .001$ . Significant numbers in bold are correlations between factors.

1 Table 3. Results of the set of psychometrics analysis

N = 239	Model A (Cann et al., 2010)	Model B (Prati & Pietrantonio, 2014)
<b>Confirmatory Factor Analysis</b>		
SB-Chi2 (df)	61.40 (25)***	<b>26.52 (25)</b>
SB-RMSEA	0.078	<b>0.016</b>
SB-CFI	0.948	<b>0.998</b>
SB-TLI	0.907	<b>0.996</b>
SRMR	0.048	<b>0.026</b>
<b>Composite Reliability (RRC)</b>		
Relating to Others	<b>0.696</b>	0.679
New Possibilities	<b>0.759</b>	0.693
Personal Strength	0.656	<b>0.703</b>
Spiritual Change	<b>0.703</b>	0.683
Appreciation of Life	<b>0.851</b>	0.803
Total Score (PTGI-SF)	0.834	<b>0.844</b>
<b>Convergent Validity (AVE)</b>		
Relating to Others	<b>0.569</b>	0.538
New Possibilities	<b>0.610</b>	0.575
Personal Strength	0.494	<b>0.543</b>
Spiritual Change	<b>0.562</b>	0.535
Appreciation of Life	<b>0.739</b>	0.670
<b>Discriminant Validity <sup>a</sup></b>		
Relating to Others	Supported	Supported
New Possibilities	Not supported	Not supported
Personal Strength	Not supported	Not supported
Spiritual Change	Supported	Supported
Appreciation of Life	Supported	Not supported

Notes. \*\*\*:  $p < .001$ ; ***Bold italic***: The better indicator value.

<sup>a</sup> For more information, please refer to Table 4.

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2 Table 4. Squared correlations (SC) among latent variables

N = 239	Model A (Cann et al., 2010)					Model B (Prati & Pietrantoni, 2014)				
	RO	NP	PS	SC	AL	RO	NP	PS	SC	AL
<b>RO</b>	0.569 <sup>a</sup>					0.538 <sup>a</sup>				
<b>NP</b>	0.452	0.610 <sup>a</sup>				0.443	0.575 <sup>a</sup>			
<b>PS</b>	0.335	0.567	0.494 <sup>a</sup>			0.397	0.608	0.543 <sup>a</sup>		
<b>SC</b>	0.190	0.344	0.168	0.562 <sup>a</sup>		0.228	0.320	0.243	0.535 <sup>a</sup>	
<b>AL</b>	0.145	0.739	0.404	0.148	0.739 <sup>a</sup>	0.278	0.771	0.600	0.194	0.670 <sup>a</sup>

Notes.

<sup>a</sup>: Average Variances Extracted (AVE) values by latent variable

**RO**: Relating to Others; **NP**: New Possibilities; **PS**: Personal Strength; **SC**: Spiritual Change; **AL**: Appreciation of Life

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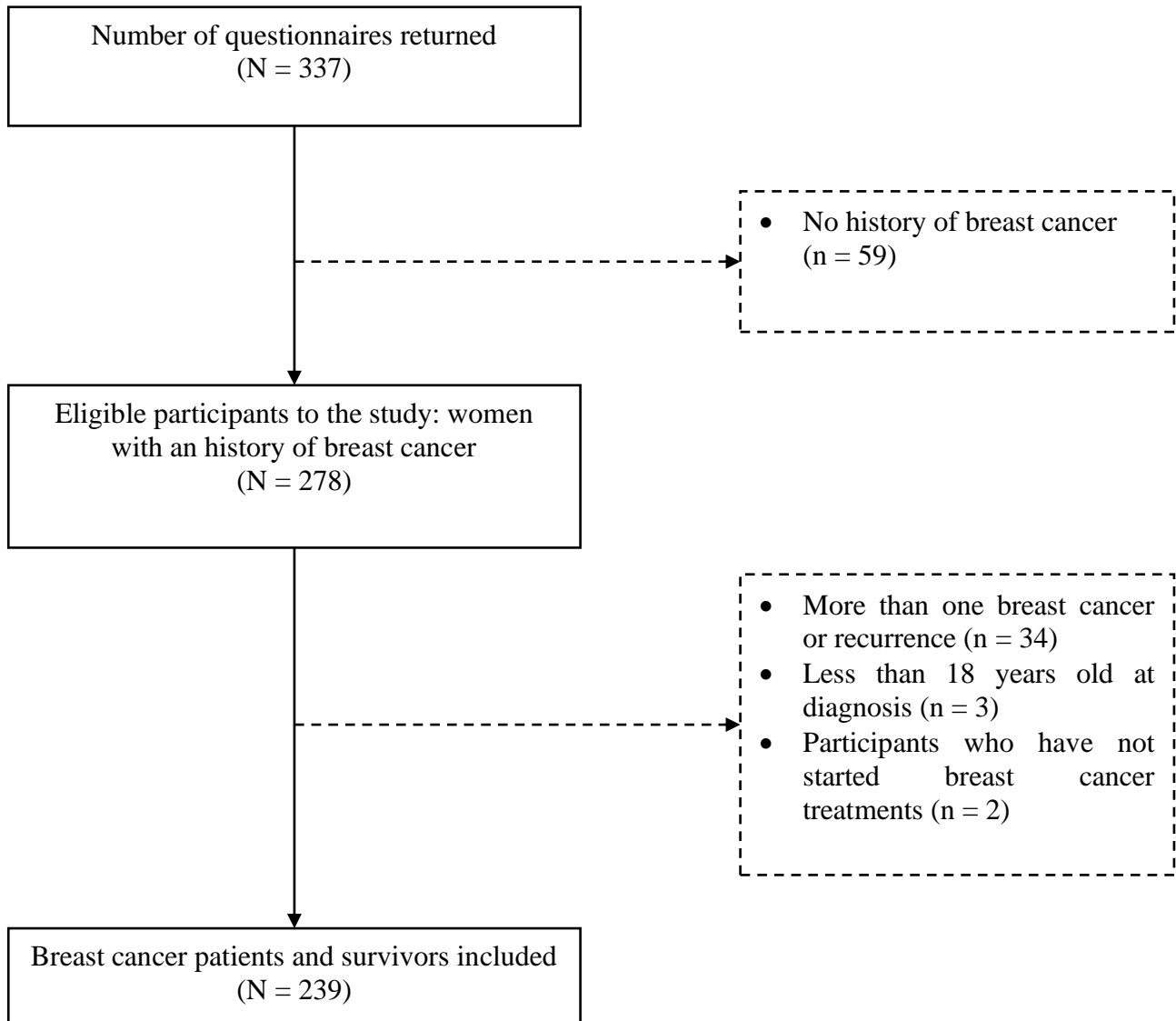


Figure 1. Participants flow diagram