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Research article

Role of neuroticism and extraversion in the emotional health of people with cancer

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ABSTRACT

The impact that cancer disease can have on individuals varies depending, among other things, on their personal characteristics, so it is important to explore aspects such as the personality traits in relation to mental health in people with cancer. The aim of this study was to analyse the relationship between neuroticism, extraversion and mental health in people with cancer. Besides, this study also explored differences in mental health when combining extraversion and neuroticism levels. One hundred and seventy people who had been diagnosed with different types of cancer (breast cancer, lung, colon, gynaecological cancer and others) composed the sample. Almost all of them (92.9%) had received oncological treatment. The GHQ-12 scale was used to assess the mental health and the 60-item NEO Five-Factor Inventory was applied in order to measure neuroticism and extraversion in participants. A hierarchic lineal regression model was conducted. Neuroticism and extraversion did not show any interaction effect, although a partial mediation was observed in relation to mental health outcomes. Given the significant correlation between neuroticism and extraversion with mental health ($r = .59$, $p < .001$; $r = -.41$, $p < .001$), both personality traits were combined, resulting in a classification of four different personality profiles ($F_{(4;165)} = 19.85$; $p < .001$). Results in this study have shown that low levels of neuroticism and high levels of extraversion are related to positive health outcomes. They seem to be protective factors with respect to the mental health in people with cancer. The knowledge of the positive effects of these aspects contributes to the comprehension of mental health in the oncological sample, which should be considered in order to design and guide particular therapeutic interventions adapted to each person.

1. Introduction

Many people suffering from cancer disease, experience high levels of emotional distress (including symptoms such as anxiety, stress, depression, etc.) that can affect their level of physical and psychological well-being (Castelli et al., 2015; Seib et al., 2018). Given that the disease process can be associated with declines in self-care, there is a need to investigate their level of mental health (Hoerger et al., 2016). In fact, the diagnosis of cancer and the disease process itself can be experienced as a traumatic event that threatens well-being and health. Consequently, identifying psychological symptoms could contribute to single out issues that should be supported and be taken care off (Silva et al., 2012).

Some studies have examined the relationship between personality and health in cancer patients. Personality refers to individual differences in cognitive processes, behavioural patterns and emotional reactions. The role of personality in cancer onset and prognosis has been largely discussed (Jokela et al., 2014). Theories based on psychosomatics have suggested that high extraversion and low neuroticism might increase cancer risk (Kissen and Eysenck, 1962). Behaviours related to emotional control and the suppression of negative emotions have been also related to predisposition to cancer (Lemogne et al., 2013). In fact, these personal characteristics have been grouped in the behaviour pattern known as "Type C" personality, which has been closely linked to cancer (Greer and Watson, 1985). Type C personality pattern is characterised by the absence of assertiveness, patience, conformity, even the inexpression of unpleasant and negative emotions, such as anger (Durá et al., 2010; Li et al., 2015).

Personality might also be related to the adoption of risky health behaviours, such as smoking, not attending cancer screenings, or even not adhering to oncological and other medical treatments (Aschwanden et al., 2019; Jokela et al., 2014). Some personal characteristics as extraversion, for instance, may lead to optimistic expectations and

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confidence in the benefits derived from cancer screenings (Neeme et al., 2015).

Regarding personality psychology, the Five Factor Model (Costa and McCrae, 1985) has been the most widely used and validated taxonomy for defining personality dimensions and includes extraversion, conscientiousness, agreeableness, neuroticism and openness to experience. Precisely, neuroticism (experiencing distress, negative emotions and being emotionally unstable) and extraversion (opposite to introversion, which refers to the tendency to be reserved, withdrawn, and inhibited) have been the most assessed features in relation to cancer disease. While extraversion has been related to positive health outcomes (Hoerger et al., 2016; You et al., 2018), neuroticism has been linked to different sources of pain and its expression, which is a common symptomatic consequence of cancer (Krok and Baker, 2014). Neuroticism and introversion have been linked to emotional distress in people suffering from prostate cancer (Perry et al., 2018; Van Esch et al., 2012). Different studies have found that both neuroticism and introversion lead to risk for developing depressive and anxiety symptoms in cancer patients (Chang et al., 2014; Hulbert-Williams et al., 2012). Individuals with high levels of neuroticism and introversion might present less adaptive coping and regulation strategies when facing potentially stressful events, which could lead to the presence of distress (Bonsaksen et al., 2019). For instance, a person suffering from cancer with a personality profile characterized by high neuroticism and emotional instability, might experience the diagnosis of cancer as more threatening or severe, and therefore will feel more fear and emotional distress. Conversely, people with tolerance for negative feelings, acceptance and hopeful thinking about illness are able to reduce stress and improve their ability to cope with cancer disease (Fini et al., 2017). On the other hand, an introvert person might look for social support to a lesser extent than an extrovert person, which could reduce his/her coping resources in terms of social support (Perry et al., 2018). In fact, loneliness and limited social support has been related to negative physical health outcomes (smoking and drinking in excess, unhealthy behaviours, thoughts of suicide, dementia, etc.) in hospitalizes cancer patients (Rokach, 2019).

Mental health has been related to personality traits, and it has been considered important to explore the role of neuroticism and extraversion in association with mental health in people with cancer. Previous studies have investigated on the effects of neuroticism on psychological health, finding that it is negatively related. Conversely, extraversion implies more positive aspects in relation to mental health. However, little research has been found combining both personality traits in relation to mental health in cancer. This study precisely analyses the specific relationship between neuroticism and extraversion, and their association with mental health in people with cancer. For this purpose, firstly, we aimed to explore if extraversion presented any moderation or mediation effect on the link between neuroticism and mental health through a hierarchic lineal regression model. Secondly, we explored the existence of different typologies in people with cancer, combining extraversion and neuroticism levels, with the goal of contributing to the comprehension of mental health in cancer disease. These analyses would provide different mental health profiles in cancer. This might be important information in order to support psychological interventions adapted to cancer patients, focused on avoiding risk factors and encouraging the protective ones.

2. Materials and methods

2.1. Participants

A total of 170 people participated in this study. They were members of the Spanish Association Against Cancer (AECC) of Biscay where they receive support and/or counselling services provided by licensed health care professionals.

Ages of the participants ranged from 20 to 82 years old ($M = 49$) and a 78.8% of them were women. All of them had been diagnosed with cancer [breast cancer (35.4%), lung (10.2%), colon (7.1%), gynaecological cancer (4%), prostate (3.9%), pancreas (2.7%), bladder (2.4%), and others (34.3%)]. Almost all of them (92.9%) had received oncological treatment (chemotherapy, radiotherapy...) and other types of medical treatments (almost 50%). 48.5% of the participants are in advanced stages of the disease (stages III and IV).

Regarding sociodemographic characteristics, most of the individuals were married (69.4%), half had a university degree (50%), and 47.6% of them were working; 6.5% were unemployed, 16.5% retired and a 25.9% were disabled to work (Table 1).

2.2. Instruments

2.2.1. Sociodemographic and clinical variables

Sociodemographic and clinical data related to the disease process were collected through a self-reported questionnaire.

Table 1. Sociodemographic and clinical variables for the oncological sample (n = 170).

Sociodemographic variables		n	%	Clinical variables		n	%
Gender	Female	134	78.8	Stages	I	15	8.8
	Male	36	21.2		II	19	11.2
Ed. Level	Primary school	18	10.6		III	22	13.0
	Secondary school	29	17.1		IV	60	35.5
	Professional training	36	21.2				
	University	85	50.0				
	Others	2	1.2				
Employment	Paid work	81	47.6	Oncological treatment	Yes	158	92.9
	Unpaid work	1	0.6		No	12	7.1
	Unemployed	11	6.5				
	Retired	28	16.5				
	Disabled	44	25.9				
	Others	5	2.9				
Civil status	Single	25	14.7	Other medical treatment	Yes	84	49.4
	Married, in couple	118	69.4		No	86	50.6
	Separated, divorced	19	11.2				
	Widower	5	2.9				
	Others	3	1.8				

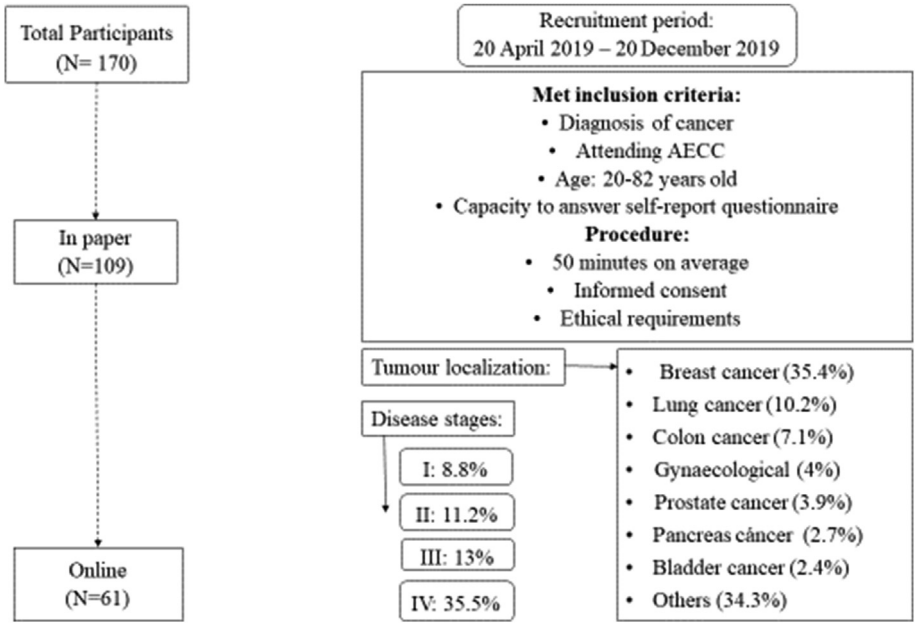

Figure 1. Flow chart of description of the methodology of the study.

2.2.2. Mental health

The General Health Questionnaire-GHQ was used to evaluate mental health (Goldberg and Hillier, 1979; Lobo et al., 1986) in its 12-items version (Sánchez-López and Dresch, 2008). The 12-items version (GHQ-12) is the most widely used screening instrument for common mental disorders. It is a self-administered screening measure developed for the detection of psychiatric disorders. Participants have to report how often they have experienced a series of symptoms in the last few weeks. The 12-items present a Likert type response format with a range of responses from 0 (better than usual) to 3 (much worse than usual). The instrument showed an adequate internal consistency with a Cronbach's alpha of .76 for the 12-items Spanish version (Lobo et al., 1986), and .94 for the present study.

2.2.3. Personality traits: neuroticism and extraversion

The 60-item NEO Five-Factor Inventory (NEO-FFI) (Costa and McCrae, 1985) was developed in order to measure the five basic personality traits. Each subscale has 12 items, which were selected from the initial pool of 180-item NEO Personality Inventory (NEO-PI) (Costa and McCrae, 1992). The instrument has a Likert type response format with five points, ranging from *0 (total disagreement)* to 4 *(strongly agree)*, for the five subscales. The direct score on each scale is obtained by adding up the subjects' responses to the corresponding items. The NEO-FFI has been translated into several different languages and has shown validity and replicability in many different contexts. The adapted version in Spanish presents good internal consistency with the following Cronbach's alpha: neuroticism (.82), extraversion (.81), openness (.76), agreeableness (.71) and conscientiousness (.81) (McCrae and Costa, 2004; Manga et al., 2004). Internal consistency for this study is neuroticism .84, extraversion .84, openness .74, agreeableness .68 and conscientiousness .85. For conducting this study, two specific indicators were selected from the NEO-FFI: neuroticism and extraversion, as they were both related to mental health in cancer patients (Perry et al., 2018). As in other studies, the remaining personality traits (openness, agreeableness and conscientiousness) did not show a significant influence on mental health (Chapman et al., 2014; Hoerger et al., 2016; You et al., 2018), showing only a minimal and insignificant contribution below 1% of variance in explaining perceived mental health outcomes in participants.

2.3. Procedure

Participants were invited to voluntarily collaborate in the study informing them of the objectives and nature of the project. Informed consent was secured in order to meet the ethical and legal requirements of the project. Participants filled a self-administered questionnaire (see Instruments), either in paper (at the premises of the association) or online, as best suited them (Figure 1). Filling the questionnaire took them 50 min on average. If any emotional reactions or problem emerged, psychologists were prepared and committed to provide them support.

2.4. Statistical analyses

Descriptive statistics were calculated for the variables of interest. To facilitate a better comprehension, all the measures were transformed to a decimal scale. Then, a hierarchic regression model was conducted to analyse if extraversion had any mediation and/or moderation effect on the relationship between neuroticism (principal variable) and mental health (output variable). Variable scores were centred before conducting the hierarchical regression analysis in order to avoid any statistical artefact, given that units of measure can affect scores. In Step 1, neuroticism (as the predictor variable) was related to mental health. In Step 2, extraversion was introduced in the model to explore if it had any mediation effect that would influence mental health scores. In Step 3, the interaction factor between neuroticism and extraversion was introduced in the model in order to analyse if it had any influence on mental health.

Scores in neuroticism and extraversion were combined, resulting in four different groups: high extraversion and low neuroticism (Group 1), high extraversion and high neuroticism (Group 2), low extraversion and high neuroticism (Group 3), and low extraversion and low neuroticism (Group 4). The robust Brown-Forsythe analysis of variance was conducted to compare the mean values of mental health in each group. In addition, Scheffé *post hoc* test was also used to explore significant differences between the groups. Finally, Cohen *d* was calculated to estimate the effect size of the differences between groups.

3. Results

3.1. Descriptive statistics

Descriptive statistics were calculated for the main variables. Considering a range score between 0 and 10 points in the three variables of interest, participants obtained an average score of 4.47 ($SD = 2.21$) in the GHQ-12, with a minimum value of 0.28 and maximum of 10 points.

Table 2. Hierarchical regression analysis of neuroticism and extraversion over mental health.

	Step 1			Step 2			Step 3		
	β	t	p	β	t	p	β	t	p
Neuroticism	.59	9.03	<.001	.51	7.27	<.001	.51	7.28	.001
Extraversion				−.19	−2.70	.008	−.19	−2.73	.007
NeuroxExtrav							.04	0.54	.591
ˆR2	.338			.363			.360		
R2	.585			.609			.610		
F	81.55			46.04			30.65		
p	<.001			<.001			<.001		

Note. β = beta coefficient; t = t-Student; p = level of significance; $\hat{R}^2$ = increase of explained variance; R^2 = coefficient of determination; F=F of Snedecor.

38.2% of the participants showed high scores in the scale, which indicates a low level of mental health. Scores in neuroticism ranged from 0 to 9.79 (M = 4.64; SD = 1.87), and from 1.04 to 9.58 (M = 6.08; SD = 1.75) in extraversion. In this case, 42.1% of the individuals had scores above 5 points, and 75.7% of them showed high scores in extraversion.

3.2. Correlational analysis

Secondly, a correlational analysis was conducted with the variables. A significant correlation was found between the personality traits and the mental health: neuroticism ($r = .59, p < .001$) and extraversion ($r = -.41$, $p < .001$).

3.3. Hierarchic lineal regression model

Thirdly, a hierarchic lineal regression model was conducted (Table 2). In Step 1, neuroticism (as the predictor of mental health), presented the same correlation that was obtained before, as it was a simple association. In Step 2, extraversion was introduced in the model to explore if it had any mediation effect, which would influence health scores. Results were statistically significant for neuroticism ($\beta = -.51$, $p < .001$) and extraversion ($\beta = -.19$, p = .008). *Sobel test* was also conducted, finding that extraversion presented a partial mediation for explaining observed mental health outcomes ($z = 2.53$; $p = .011$). Nevertheless, in Step 3, the interaction factor between both variables of neuroticism and extraversion was introduced in the model, but it did not show any interaction effect (Figure 2). This means that the relation between the main variables was linear, in the absence of interaction.

3.4. Personality typologies and mental health

Additionally, considering the theoretical significant contribution of variables of neuroticism and extraversion in relation to cancer patients' health, these variables were analysed with the aim of exploring if the combination of different levels of neuroticism and extraversion was related to differences in mental health.

Figure 3 shows the comparison between the scores obtained by each group on mental health: 45.9% of the participants showed high extraversion and low neuroticism (Group 1), 25.3% showed high extraversion and high neuroticism (Group 2), 13.5% showed low extraversion and high neuroticism (Group 3), and 11.8% presented low extraversion and low neuroticism (Group 4).

The analysis of differences in mental health is presented in Table 3. As it can be seen, there are statistically significant differences (F (4; 165) = 19.85; $p < .001$). The most important differences have been found between Groups 1 and 2 ($t = -2.30$; $p < .001$; $d = 1.30$) and Groups 1 and 3 ($t = -1.35$; $p < .001$; $d = 1.35$). Although significant differences among the other groups were not found, comparisons between groups 1 and 4 ($d = .72$), groups 2 and 4 ($d = .55$) and groups 3 and 4 ($d = .58$) have shown notorious effect sizes, denoting clinical importance of the typology in differentiating levels of mental health.

4. Discussion

Considering the influence of personality predispositions in cancer patients' mental health, the aim of this study was to explore the relationship between neuroticism and extraversion, and their link with mental health in people with cancer. Both personality traits have been

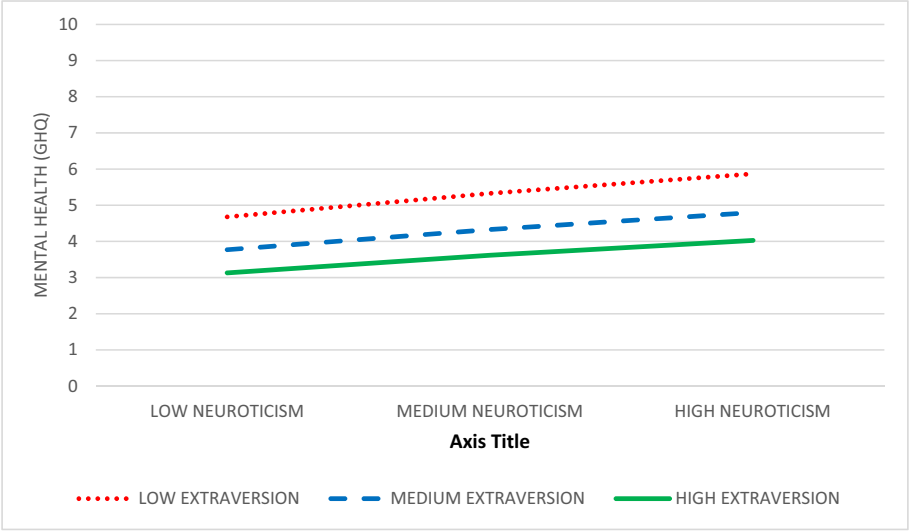

Figure 2. Prediction of mental health scores as a function of neuroticism and extraversion.

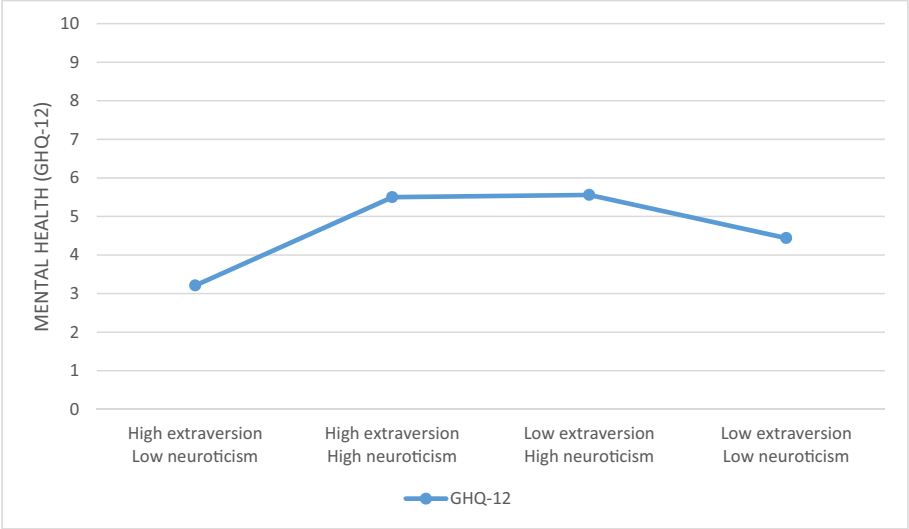

Figure 3. Mental health typologies regarding neuroticism and extraversion levels in cancer.

Table 3. Cancer patients' typologies regarding scores in neuroticism, extraversion and GHQ-12.

	G1 (n = 77)		G2 (n = 37)		G3 (n = 28)		G4 (n = 17)		F	Post-hoc (d)					
	M	SD	M	SD	M	SD	M	SD		1–2	1–3	1–4	2–3	2–4	3–4
GHQ	3.21	1.68	5.50	1.95	5.56	1.98	4.44	1.94	19.85*	1.30*	1.35*	.72	.01	.55	.58

Note. n: sample size; M: mean; SD: standard deviation; F: F of Snedecor; d: Effect size, Cohen's d coefficient; Typologies: G1 - high extraversion and low neuroticism (Group 1); G2 - high extraversion and high neuroticism (Group 2); G3 - low extraversion and high neuroticism (Group 3); and G4 - low extraversion and low neuroticism (Group 4). *p= <.001.

correlated with health, positively with neuroticism (which means a lower level of mental health) and negatively with extraversion (the more introvert the lower scores in mental health). This result confirms what other studies have found about that relationship, indicating that both neuroticism and introversion (the opposite of extraversion) are linked to a higher risk of presenting emotional distress in people with cancer, and consequently, a lower level of physical and psychological health and well-being (Chang et al., 2014; Hulbert-Williams et al., 2012).

Considering the significant correlation between the variables of interest, one of the goals of this study was to analyse if extraversion had any effect (moderation or mediation) on the relationship between neuroticism and mental health. Results did not show an interaction effect, as expected when conducting the hierarchical regression model, showing a lack of interaction between neuroticism and extraversion in relation to mental health. However, a partial mediation effect was observed. Therefore, both variables contribute to explain part of the variance in mental health. The largest effect is attributed to neuroticism, and a smaller effect, although significant, is attributed to extraversion.

With the aim of exploring the role of neuroticism and extraversion on participants' mental health more deeply, both personality traits where combined. The aim was to explore if differences in mental health existed in different personality profiles. Findings in this study showed that the group of participants with high level of extraversion and low level of neuroticism (Group 1) was the one with lower scores in the GHQ, which means higher levels of mental health.

In contrast, participants who presented higher levels of neuroticism (Groups 2 and 3) showed lower levels of mental health. These results confirm what other studies have found about the negative influence of neuroticism on cancer patients' health (Hulbert-Williams et al., 2012; Van Esch et al., 2012). Neuroticism has been related to physical symptoms of the disease, such as pain expression and fatigue (Krok and Baker, 2014; Wang et al., 2013). Furthermore, presenting neurotic personality characteristics might lead to a poorer psychological and mental health, as people tend to experience life events as more threatening and distressing (Perry et al., 2018). In short, as can be seen, neuroticism is associated with an increased risk of poorer mental health outcomes (Krok and Baker, 2014).

However, participants who presented low levels of neuroticism and also low levels of extraversion (Group 4) obtained considerably higher scores in the GHQ-12, showing lower levels of mental health. It is noteworthy the significance of this result: low levels of neuroticism, combined with high introversion is related to poor mental health. Although statistically significant differences are not found when comparing Group 4 with the rest of the groups, it does not mean that there cannot be clinically significant implications in these results. These findings support the idea that extroversion is a protective factor of mental health in cancer patients. Other studies have found similar results, especially regarding the negative impact of introversion on health (Perry et al., 2018). Having significant relationships with friends, partners, and even healthcare professionals seems to be important to achieve an optimal emotional and psychological adaptation to the disease (Chindaprasirt et al., 2019; Rokach, 2019; Saita et al., 2015).

In conclusion, both low neuroticism and high extraversion seem to be protective personality traits. Nevertheless, other studies did not found any relationship between personality features as neuroticism and extraversion and cancer patients' mental health (Nakaya et al., 2010; Ranchor et al., 2010). However, this research has provided evidences in the same direction of what other studies have found about the link between neuroticism and introversion with a maladaptive coping and poorer emotional, cognitive and behavioural strategies when facing the disease (Perry et al., 2018; Saita et al., 2015). Cancer patients with higher levels of neuroticism and introversion are more prone to develop distress and both physical and cognitive fatigue (Wang et al., 2013).

4.1. Limitations

In terms of the limitations in this study, it would be advisable to try to increase the homogeneity of the sample, especially with respect to the types of tumours and the stage of the disease. In this way, it would be interesting to try to compare different groups with the aim of analysing the results separately.

Secondly, our model has not shown any interaction between the variables of neuroticism and extraversion; it would be desirable to analyse this relationship deeply. In fact, when combining the results between those variables, although there are not statistical differences for some groups, effect sizes result to be considerable. If the sample is increased, we might be able to find further evidences, especially clinical significances. Likewise, it would be worthwhile to assess the level of perceived social support in participants. This would be useful in order to explore which aspects are related to the protective and positive effects of extraversion in people with cancer, considering the importance of the fact that extrovert people are more prone to seek social support, which could help coping with the disease process.

Furthermore, it would be also interesting to explore deeply the mental health and other variables of result such as quality of life in relation to other personality traits in cancer patients. For example, exploring the role of the other dimensions of the Five Factor Model, such as conscientiousness, agreeableness and openness to experience.

The cross-sectional design of the study is a limitation. A longitudinal design with at least two evaluation moments would allow us to better explore the specific influence of neuroticism and extraversion on participants' mental health.

4.2. Clinical implications

Results have shown the protective effects of presenting high levels of extraversion and low levels on neuroticism on participants' mental health. Considering these evidences, it would be advisable to design psychotherapeutic interventions that could mitigate the effects of some personality traits. Despite the structural character of personality, some features such as neuroticism and introversion have some behavioural, cognitive and emotional consequences that could be moderated in order to reduce distress in patients. Considering the stressful impact that cancer has on people's daily lives, it would be desirable to prepare them to have a more adaptive coping style, which would allow them to seek social support and try to reduce the stressful and threatening cognitions that can disturb them. These specific actions would contribute to reduce distress, anxiety and depression on participants, consequently improving levels of quality of life and in general, the perception of health.

5. Conclusion

This study highlights the relation between certain personality traits with cancer patients' mental health. On the one hand, neuroticism seems to be a risk factor for psychological health. People characterised by a neurotic personality are more prone to experience life events as more threatening and distressing than other people do (Perry et al., 2018). This might affect the person's quality of life, consequently, leading to an increase of the levels of stress and anxiety, especially considering the intrinsic characteristics of the disease process. Besides, extroversion has shown to be also a protective factor in people with cancer. Extrovert people usually tend to seek social support to a larger extent than introvert people, what could be precisely supportive for people suffering from a chronic disease. Apparently, there is not a mediation or moderation relationship between neuroticism and extroversion and mental health; however, when both personality traits are combined, differences are observed. The existence of these typologies contribute to the understanding of the importance of presenting a low level of neuroticism and a high level of extraversion, that become protective factors with respect to mental health in the oncological sample. Despite the limitations of the study regarding the size variability and its cross-sectional nature, it contributes to the scientific evidence providing information about cancer patients' mental health profiles. The research underscores the relevance of encouraging adaptive coping styles based on distress reduction and extravert behaviours directed to seek support from relatives and close friends. These findings are important for psychologists who work in the health field, and more especially, in the oncological area. The knowledge of the protective effects of these factors enables improved health outcomes that should be considered in order to design and guide particular therapeutic interventions adapted to each person's reality.

Declarations

Author contribution statement

P. Macía, I. Iraurgi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

S. Gorbeña: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

A. Gómez: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

M. Barranco: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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