




# Relationship between anxiety level and radiological investigation. Comparison among different diagnostic imaging exams in a prospective single-center study

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## Abstract

**Objective** Every patient could feel anxious when he waits in a radiological department to undergo diagnostic exams. The aim of our study is to evaluate the impact of the radiological exams on patient anxiety.

**Materials and methods** We evaluated 343 patients (mean age 54.83 years) who underwent different types of diagnostic exams in the Department of Diagnostic Imaging at our Hospital from April 2013 to August 2014. We administered to patients the State and Trait Anxiety Inventory Test, which detected with high sensitivity both state anxiety and trait anxiety. A team of clinical psychologists and radiologists evaluated the scores obtained.

**Results** 83 out of 343 patients were excluded because refused to file the questionnaire. 31 % of the patients were

submitted to MR, 18 % to breast imaging, 10 % to X-ray, 22 % Computer Tomography and 19 % to ultrasound, as previously described. 41 % of patients were submitted to the examination because of an oncologic disease, while 59 % because of non-oncological disease. Therefore, it was found that high levels of anxiety were present in most (about 91 %) of the patients and the scores varied according to the imaging examination and to the examination's reason: anxiety level was higher in non-oncological patients (54 %) and in patients waiting to undergo to MRI exams (29 %).

**Conclusion** Our data suggest that the diagnostic exams are stressful events for the patient, also in non-oncological patients. So, it is important to adequate the radiological staff to receive the patient, to inform him and perform

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exams with emotive involvement with a targeted education. Also, further studies are needed to evaluate the anxiety level and the quality of the images, because the anxiety can result in a somatic disorder with hyperactivity of the autonomic nervous system which may affect the patient's physical examination, causing problems in the evaluation of radiological images making to non-cooperative patient. MRI imaging is the examination that more of all led to an anxious state of patients but the main stressor is not related to the type of diagnostic examination, but to the uncertainty of the diagnosis, therapy and prognosis.

**Keywords** Anxiety · Quality of life · Social support · Oncology · Diagnostic imaging · STAI

## Introduction

In the last decades, there has been an increasing request of radiological examinations. Due to the increase in life expectancy of the general population, spreading and increasing adherence to screening programs, and the effectiveness of medical and surgical therapies that increased the prevalence of oncological diseases, there has been an exponential increase in the number of radiological examinations performed for screening, diagnosis, and follow-up of diseases [1].

However, these procedures may often lead to emotional impairment of patients, as anxiety that appears to a common feeling. Anxiety is mainly due to the fear of the uncertainty of procedure, results of the examination, and possible consequence of invasive or not and health impairment [2].

Uncertainty and worry lead to anxiety as a primary physiological adaptation, which can result in a simple emotional reaction to a possible “dangerous condition” in some patients or, for other patients, it can result in a psychological disorder. Both these kinds of anxiety may be acute or chronic [3].

Acute anxiety is felt in critical moments as during the execution of exams, waiting for the report, during the communication of the diagnosis and diagnostic procedures and during the treatment (surgery, chemotherapy, radiotherapy) or when the patient is told about the recurrence of his disease. This form of anxiety may present with both psychological and somatic symptoms [4].

The first consists in concern for health (e.g., worries for future own problems and for relatives), in the sense of anxious waiting, in the worry, fear and expectation of danger, restlessness and difficulty in concentrating. On the other hand, somatic symptoms cause a hyper activation of the central nervous system, thus causing motor restlessness, tremors, headache, sleep disturbances, autonomic symptoms (sweating, hot flashes or chills), dry mouth, dizziness,

palpitations and paresthesia, thoracic pain and dyspnoea, urinary urgency and gastrointestinal symptoms [5].

Chronic anxiety may present in many significant clinical scenarios such as generalized anxiety, simple phobia and social phobia.

Therefore, patients waiting to undergo diagnostic radiological procedures may feel a high emotional experience, characterized by a degree of anxiety that is different for each patient, and can be responsible for a strong psychophysical stress and impairment during the examination [6].

The purpose of our study was to find stressors factors, in order to enable specific strategies to reduce anxiety in patients, improve compliance and optimize the execution of diagnostic examinations.

## Materials and methods

From April 2013 to August 2014, 343 patients waiting to undergo diagnostic examinations in the Radiology Department of the University Hospital of Palermo were recruited. According to the diagnostic examination performed, five different randomized groups were distinguished: breast examinations, ultrasound (not breast), X-ray, computed tomography and magnetic resonance. The institutional review board approved this prospective single-centre study.

Before being submitted to the respective exam, all patients were asked to sign an informed consent for being submitted to the exam, making them aware of the respective imaging technique (ionizing radiation, electromagnetic waves) and the related risks, as adverse drug reaction related to contrast medium (if planned).

Moreover, all patients were informed before being submitted to the psychological test about the aim and modalities of this study and an informed consent to participate was obtained. Then, the patients received the questionnaire that was divided into two parts, respectively: the first part about the socio-demographic information (age, sex, level of education, occupation and marital status) and the second part about the clinical data related to the type of technique and reason of examination (first diagnosis, screening or follow-up) and referring reason distinguishing specifically for oncological diseases. All the completed questionnaires did not contain any personal data that could indicate the identity of patients in any way.

## State and trait anxiety inventory test

The evaluation and measurement of anxiety levels have been performed administering the State and Trait Anxiety Inventory Test (S.T.A.I.), in particular the scale Y 1 that investigates the anxiety status [7].

S.T.A.I. test is a standardized questionnaire, consisting of 40 questions on a self-report basis; questions are grouped into two subscales of 20 items that, respectively, assess state and trait anxiety: state anxiety Y1 (this index refers more to the anxiety at the time of a perceived event and is considered temporary: the patient is asked how he feels in a particular circumstance) and trait anxiety Y2 (refers to a personality trait seen as a personal behavioral attitude towards anxiety: the patient is asked to indicate how they generally feel).

### Medical staffs of the department-assisted patients when requested

The 40 questions are evaluated based on a 4-point Likert scale corresponding to the following answers: for S-anxiety (1) not at all, (2) somewhat, (3) moderately so, (4) very much so; for T-anxiety (1) almost never, (2) sometimes, (3) often, (4) almost always.

### Statistical analysis

All S.T.A.I. tests were evaluated by a team of clinical psychologists and radiologists.

They considered several parameters including the type of examination and reason of the examination (first diagnosis, screening or follow-up), with a particular reference to patients with known oncologic disease and to patients waiting for mammography (referring reason suspected cancer not screening). In particular, the specific objectives were:

1. Evaluation of cutoff levels of anxiety in participants;
2. Definition of the different level of anxiety in each randomized group (mammography, ultrasound, CT, MR, X-ray).
3. To compare levels of anxiety between oncologic and not-oncologic patients.

Thereafter, a descriptive analysis was performed (mean, standard deviation SD, percentages).

In particular, the Fisher exact test was used to compare differences in discrete or categorical variables. Statistical significance was defined as  $p$  less than 0.05. Data analysis was performed through the statistical system Statistical Package for Social Sciences (SPSS v. 13.0, IBM Corp., Armonk, NY, USA) 13th version.

### Results

83 out of 343 patients were excluded because they did not want to participate to the study or not adequately filled the questionnaire. 164 of the 260 patients (63 %) agreed

to participate to the study were females. Epidemiological information is reported in Table 1.

Concerning clinical data, 31 % of the patients were submitted to MR (excluding breast MR), 18 % to breast imaging (mammography, ultrasound or breast MRI), and then 10, 22 and 19 %, respectively, to X-ray (excluding mammography), CT and ultrasound (excluding breast US) (Fig. 1). 41 % of patients were submitted to the examination because of an oncologic disease (Fig. 1).

Regarding the threshold levels of anxiety in participants (cutoff), there was evidence that this value was exceeded in most (about 91 %) of the patients and the scores varied according to the imaging examination and to the reason for performing the examination: anxiety level was higher in non-oncological patients (54 %) and in patients waiting to undergo to MRI exams (29 %).

A lower percentage of patients waiting for breast imaging or ultrasound experienced anxiety is shown in Table 2.

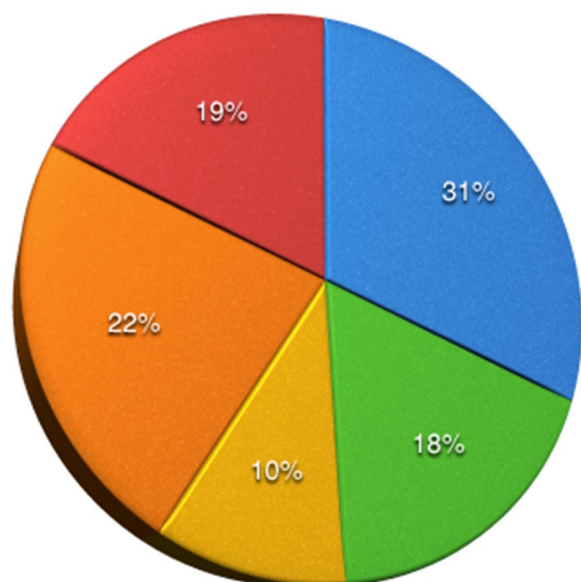
Oncologic patients had lower anxiety levels compared to non-oncologic patients, maybe because they are waiting for a follow-up examination. Non-oncologic patients showed 21 % of severe anxiety, 17 % of moderate and 16 % of mild. On the other hand, considering oncologic patients, 11 % had severe anxiety levels while most of them had moderate/mild levels (Table 3).

Patients with higher school education (university degree) showed lower anxiety levels compared to those with lower school education (elementary, middle and high school),

**Table 1** Epidemiological data

	No.	%
Gender		
Male	96	37
Female	164	63
Marital status		
Married or in a stable union	174	67
Single	50	19
Separated	15	6
Widow	21	8
Education		
Elementary or below	49	19
Middle school	71	27
High school	89	34
University or higher	51	20
Occupation		
Intellectual-scientific	25	10
Business, services	11	4
Public service	50	19
Farming/fishing	13	5
Technical	2	1
Unemployed	158	60

● MR ● Brest imaging ● X-ray ● Ct ● Ultrasound



**Fig. 1** Distribution of the diagnostic examinations

**Table 2** Correlation between anxiety level and types of exams

Anxiety level	0 (%)	1 (%)	2 (%)	3 (%)
Types of exams				
Breast imaging	1	4	8	5
Ultrasound	1	4	11	3
MRI	2	8	10	11
CT	2	3	11	6
X-ray	4	3	2	1
Total	10	22	42	26

**Table 3** Correlation between anxiety level and oncologic disease

Anxiety level	0 (%)	1 (%)	2 (%)	3 (%)
Patients				
Oncologic	4	11	15	11
Non-Oncologic	5	16	17	21
Total	9	27	32	32

with a significant  $p$  value ( $p < 0.0005$ ): anxiety was felt in just 13 % of university graduated patients, in 30 % of patients graduated at high school, in 29 % of patients with middle school and in 28 % of patients with primary school (Table 4).

Moreover, women showed higher levels of anxiety (61 %) than men (33 %) and, among females, the higher scores were obtained in patients waiting for mammography (Table 5).

**Table 4** Correlation between anxiety level and instruction

Anxiety level	0 (%)	1 (%)	2 (%)	3 (%)
Education				
Elementary or below	1	7	6	14
Middle school	2	7	10	10
High school	2	7	11	10
University or higher	6	4	2	1
Total	11	25	29	35

**Table 5** Correlation between anxiety level and gender

Anxiety level	0 (%)	1 (%)	2 (%)	3 (%)
Gender				
Male	3	11	10	12
Female	3	19	24	18
Total	6	30	34	30

## Discussion

Nowadays, the increase in longevity and the development of new diagnostic and therapeutic strategies lead to a raise in the number of people submitted to diagnostic, screening or follow-up examinations [2]. The direct consequence has been the prevention and the improvement of the outcome of many diseases. On the other hand, the expectation of negative communications or events, often due to the fear of having a disease, raised psychophysical stress. Our results let us emphasize that patients waiting for diagnostic procedures often manifest symptoms related to anxiety. The fear to undergo a new radiological procedure, the possibility of risks examination and the uncertainty about the outcome of the diagnosis are responsible for patients' fear and anxiety [8].

This means that medical staff must support patients that should experience severe levels of anxiety, since their anxiety may be clinically significant.

Our study proved a difference in the levels of stress related to the type of diagnostic imaging technique: patients waiting for an MRI scan showed highest levels of anxiety compared to those waiting for CT, although MRI does not imply the use of ionizing radiation. Although electromagnetic waves used in MRI are not harmful for human health, patients are worried more when they have to undergo an MRI examination rather than TC; this is probably due to the fact that CT is a more common investigation, requires less time, is generally best known and, therefore, patients are more aware of this examination [9].

According to our data, anxiety is not directly correlated with the imaging technique but with the fear of being submitted to a second level examination.

Moreover, in our study the highest levels of anxiety were seen in patients waiting for ultrasound examinations; this is probably a bias related to the fact that in our Department of Diagnostic Imaging the ultrasound report is delivered to the patient at the end of the examination, while CT, MRI and mammography reports will be delivered within a few days. Hence, patients waiting for US examination experienced highest levels of anxiety probably because of the likely imminent delivery of the report (Table 2) [9].

Higher anxiety levels have also been found among patients with suspected oncologic disease: the mere suspicion of a cancer diagnosis can therefore elicit strong emotional reactions in patients, as the fear of possible need of surgery, or long and difficult medical treatments and even the fear of death [10].

The diagnosis of cancer is such a traumatic event that it can induce the patient to a redefinition of his life. The time of diagnosis and subsequent treatments evokes intense emotional reactions ranging from feelings of worry and loneliness to feeling of fear and death. On the other hand, oncologic patients waiting for follow-up examinations showed lower levels of anxiety; hence, the biggest stressor is the fear of the unknown both considering diagnosis and subsequent eventual therapy. Moreover, we noticed that females experienced higher levels of anxiety; this could be explained not just because of the fear of death but also because of the possible adverse effects of chemotherapy and radiotherapy, as hair loss or weight loss, etc.) since these effects may lead to a change in their body figure and identity, mainly after surgical therapies as quadrantectomy or mastectomy [11].

Our study suggests also that a higher school education is correlated with a more deep knowledge of the examination, disease and therapy and this leads to a reduction of the levels of anxiety.

Hence, as already demonstrated by previous studies [12, 13] our results demonstrate that radiological diagnostic examinations are responsible for strong emotional reactions and, among these, appear to be the main emotional response that often results in physical symptoms because of hyperactivity of the autonomic nervous system [14]. These symptoms can make the patient less cooperative during this examination [15].

Understanding the causes and the reasons for those fears is the first and necessary step to develop specific measures aimed at preserving the mental and physical patient health as well as to improve his compliance.

Concerning women who are waiting for breast imaging, their anxiety may be related to the fear of a severe disease, the breast carcinoma, that is one of the most frequent diagnosis in females.

## Conclusion

Our clinical practice suggests that the diagnostic exams are stressful events for the patient, also in non-oncological patients.

Also, further studies are needed to evaluate the anxiety level and the quality of the images, because the anxiety can result in a somatic disorder with hyperactivity of the autonomic nervous system which may affect the patient's physical examination, causing problems in the evaluation of radiological signs and making the patient less cooperative during the exam [16]. As revealed in this study, MRI imaging is the examination that more of all led to an anxious state of patients but the main stressor is not related to the type of diagnostic examination, but to the uncertainty of the diagnosis, therapy and prognosis.

The final quality of the images obtained is inversely proportional to patient's levels of anxiety [17]. Several studies have shown that the level of preoperative anxiety is a predictor of the pain experienced during procedures; moreover, more anxious patients tend to require longer treatments, with the administration of a greater number of drugs and an increase in the risk of adverse events. Radiologists and medical staff are not trained and do not have adequate skills and time to provide psychological support to patients.

For these reasons, resources should be reorganized: In order to reduce patient anxiety while waiting the examination and make him more cooperative during the exam, it might be useful to pay attention to the anxiety level of patients in the radiology waiting rooms, as it commonly happens in oncologic ambulatories, mainly in breast imaging and MRI units [18]. Furthermore, there is surely the need for closer cooperation among the various professionals (radiologists and clinical psychologists) to optimize patients' outcomes and improve the efficiency of radiologic services and diagnosis.

Finally, should be useful professionalize the radiological staff to receive the patient, to inform him and perform exams with emotive involvement with a targeted education.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical standards** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed consent** This prospective single-center study was approved by our institutional review board. Informed consent was waived due to its retrospective nature.

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