Acta Diabetol (2015) 52:513–521
DOI 10.1007/s00592-014-0686-8

ORIGINAL ARTICLE

Post-traumatic stress disorder, coping strategies and type 2 diabetes: psychometric assessment after L'Aquila earthquake

Giacomo Ciocca · Eleonora Carosa · Maria Stornelli · Erika Limoncin · Giovanni L. Gravina · Rossella Iannarelli · Alessandra Sperandio · Stefania Di Sante · Andrea Lenzi · Davide Lauro · Emmanuele A. Jannini

Received: 12 August 2014 / Accepted: 3 November 2014 / Published online: 19 November 2014
© Springer-Verlag Italia 2014

Abstract
Aim After natural and collective catastrophes, many behavioral phenomena can occur through psychobiological responses that involve also the diabetic condition.The aim of this study was to investigate post-traumatic stress disorder (PTSD) and coping strategies in type 2 diabetic patients after L'Aquila earthquake, with a particular attention to the newly diagnosed patients and to the gender differences.
Methods Among the local diabetic population, we recruited 100 diabetic patients (46 women and 54 men). Sixty of these had diabetes before the earthquake (pre-quake patients), and other 40 received diabetes diagnosis after the earthquake (post-quake patients). A psychometric protocol composed by Davidson Trauma Scale for PTSD and Brief-COPE for coping strategies was administered.
Results We found significant differences in the levels of PTSD when comparing both post-quake with pre-quake patients (post-quake = 51.72 ± 26.05 vs. pre-quake = 31.65 ± 22.59; $p < 0.05$) and the female patients with males (women = 53.50 ± 27.01 vs. men = 31.65 ± 23.06; $p < 0.05$) and also in the prevalence [post-quake = 27/40 (67.5 %) vs. pre-quake = 20/60 (33.3 %); $p < 0.05$], [women = 27/46 (58.69 %) vs. men = 16/54 (29.62 %); $p < 0.05$]. Moreover, maladaptive coping was a predictive factor for PTSD in the post-quake group only (OR 1.682; 95 % CI 1.155–2.450; $p = 0.006$).
Conclusions Our results revealed that PTSD may be considered an important comorbidity factor in newly diagnosed patients and in diabetic women. Hence, a psychological support seems particularly important in these patients after a collective traumatic event to help them react to both PTSD and diabetes and to help them improve their coping skills.

Keywords PTSD · Coping strategies · Type 2 diabetes · Earthquake · Psychometric assessment

Managed by Antonio Secchi.

G. Ciocca · E. Carosa · M. Stornelli · E. Limoncin · G. L. Gravina
Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, L'Aquila, Italy

R. Iannarelli · A. Sperandio
Unit of Diabetology and Metabolic Diseases, San Salvatore Hospital, L'Aquila, Italy

S. Di Sante · A. Lenzi
Department of Experimental Medicine, Sapienza University of Rome, Rome, Italy

D. Lauro · E. A. Jannini (✉)
Department of Systems Medicine, Tor Vergata University of Rome, Via Montpellier 1, 00131 Rome, Italy
e-mail: eajannini@gmail.com

Introduction

On April 6, 2009, a 6.3-magnitude earthquake hit L'Aquila, a town in central Italy with 70,000 inhabitants. In 30 s, the earthquake caused 309 victims and 1,500 injured, and largely destroyed the town's historic center as well as thousands of houses [1].

Evidence shows that there are specific personal and social behavioral changes after wars or natural catastrophes [2–4]. When an individual is exposed to a very stressful event, the behavioral response is hyperactivation or paralysis and the somatic response is characterized by hyperactivity of the autonomous nervous system and the hypothalamus–pituitary–adrenal axis (HPA) [5, 6].

Post-traumatic syndrome is represented by a continuous state of alarm, even in the absence of direct negative stressors, and the post-traumatic stress disorder (PTSD) is a complex psychopathological disease that could develop after a traumatic event [7, 8].

Its assessment and treatment are problematic, as its symptoms belong to the anxious/depressive spectrum, with somatic correlates [6, 9]. The principal symptoms of PTSD are classified into three clusters: intrusion, avoidance/numbing and hyperarousal [6, 8]. However, other investigations have discussed about the criteria and the prevalence of PTSD, on the basis of the use of Diagnostic and Statistical Manual of Mental Disorders fourth edition (DSM-IV) or DSM-V [10, 11].

After L'Aquila earthquake, many empirical studies on effects of trauma on particular local populations regarding the adolescents, the gender differences, the pregnant women and the psychotic patients were made [3, 12–14].

Regarding the prevalence, Dell'Osso et al. [15] have found a percentage of 37.5 % of PTSD cases in a large sample of students, assessed with self-report psychometric tools. On the other hand, other researchers, using telephonic interviews, found only the 4.1 % of people affected with post-traumatic stress [16]. Generally, the great variability of data regarding the prevalence of PTSD after collective traumas depends on the methodology of investigation and on the severity of the disaster, with a range of prevalence between 4 and 87 % [17].

Moreover, the personal vulnerability to PTSD is caused by many endogenous and exogenous factors. In this regard, the coping strategies play a fundamental role against PTSD.

Lazarus [18] classified coping responses as either problem-focused or emotion-focused. In a study concerning coping strategies in the mental diseases, Meyer made a further subdivision in adaptive and maladaptive coping, on the basis of Carver's model [19].

Another very significant aspect regards the physical illnesses in the population after catastrophes or collective traumas. PTSD, with its psychobiological consequences, also has a role in chronic and metabolic pathologies, as diabetes [20]. In fact, some studies also suggest that chronic or acute distress may affect the metabolism of glucose and increase the risk of developing type 2 diabetes [21–26]. In particular, an important and recent investigation demonstrated the link between PTSD and diabetes in a large study population [27], showing a possible cause–effect link between traumatic stress and diabetes due to the dysregulation of HPA and the related increase of corticotropin and cortisol, that plays a role in the pathogenesis of diabetes [28]. On the whole, it is known that many psychological elements, as depression, anxiety and mood disorders, are involved in the diabetes [29–32].

Given this background, the primary hypothesis of this study concerns the people that survived the earthquake and after were diagnosed with diabetes. Therefore, we hypothesized a major prevalence and severity of PTSD in patients diagnosed with diabetes after the earthquake.

Moreover, we know that PTSD occurs more in women that in men, and this evidence verified also in the local general population. In addition, literature affirms that in diabetic people another mental disease, as depression, specifies female diabetic population. Considering these aspects, we also hypothesize a possible major prevalence and a higher severity of PTSD in women with diabetes than in men. Hence, the secondary hypothesis regards the gender differences with a major severity of PTSD in women with diabetes than in men [3, 33–35].

Objectives

According to our hypotheses, the first aim of this investigation focuses on the psychometric evaluation of PTSD and the coping strategies in type 2 diabetic patients diagnosed at least 6 months after the L'Aquila earthquake of April 6, 2009.

The second aim regards the possible gender differences in PTSD and in the use of coping strategies in our selected diabetic patients.

Materials and methods

Sample recruitment

At the Unit of Diabetology and Metabolic Diseases of San Salvatore Hospital, L'Aquila, we consecutively recruited 100 patients aged 30–65 with diabetes mellitus type 2 who had lived through the earthquake. This sample represented about the 10 % of the local diabetic population, considered on the basis to our inclusion criteria. Sixty of these had suffered from diabetes before the earthquake (pre-quake patients). The remaining 40 were diagnosed at least 6 months after the earthquake (post-quake patients). Into the entire group, we enrolled 54 men and 46 women.

The inclusion criteria were to be resident in L'Aquila, to have lived through the earthquake and to have lived post-quake in a hotel, tent, camper or caravan for between 1 and 6 months.

We excluded all patients with vascular, neurological, renal, retinal or hormonal complications and with diabetes diagnosed more than 10 years earlier. We also excluded patients who had suffered major events such as death in the family caused by the earthquake or who were physically

injured by the collapse of their home, or who had a personal story of previous traumatic experiences.

A clinical psychologist assessed all subjects according to DSM-IV, through a clinical interview, to exclude severe mental disorders, as psychosis or major depression, while a diabetologist examined the patients for blood glucose levels and general health.

Hence, a first part of our study regarded the following subdivision: pre-quake patients and post-quake patients. A second part regarded the gender differences into diabetic people.

All assessments and data refer to the 6-month period from June to December 2012.

The study protocol was approved by the San Salvatore Hospital ethics committee for investigations involving human subjects in line with the Declaration of Helsinki, and all patients signed their informed consent to the handling of personal data.

Assessment

Two self-report tests were used: the Davidson Trauma Scale (DTS) [36] and the Brief-COPE [19, 37]. The Davidson Trauma Scale is a self-report questionnaire composed of 17 items with four possible Likert scale responses exploring both severity and frequency of symptoms. All 17 items explore the first open question of the test (what was the most traumatic event for you?). This psychometric tool has been validated for PTSD diagnosis relative to a specific traumatic event and excluding other possible traumas. The cutoff total score for PTSD diagnosis is $\geq$40. The correction grid indicates the partial scores for PTSD severity and frequency as well as the severity of the three main symptoms of post-traumatic stress: intrusion, avoidance/numbing and hyperarousal.

The Brief-COPE is a well-validated psychometric tool structured in a 28-item test with a 4-response Likert scale evaluating 14 specific coping strategies. By using Brief-COPE, we evaluated two coping domains: adaptive coping (the first eight scales) and maladaptive coping (the last six scales) [38].

For the biological assessments, we collected blood sticks picked up in the morning between 8 and 10, before breakfast. These were tested in the diabetes center according to the normal clinical workup. All biometric assessments were collected once, in the same period as the administration of the psychometric tools.

Statistical analysis

The power of analysis indicated that with a local diabetic population, composed of about 4,000 patients and an estimated prevalence of PTSD of 25 %, a sample of 100 diabetic patients would provide a 95 % confidence interval representing 10 % of the considered population.

To compare continuous variables, Student's T test for non-matched data and assuming an equal variance was used.

The difference between categorical variables was tested using Chi-square test or Fisher's exact test, when appropriate. Chi-square test was chosen to investigate the differences in the prevalence of PTSD in the groups. Univariate logistic regression was employed to verify possible predictive factors at time of PTSD, assuming DTS cutoff score (presence/absence of PTSD) as dependent variable and coping strategies, years of diabetes and age as independent variables. The statistical analysis was made with MedCalc software.

Results

PTSD in newly diagnosed patients

In the first 100 patients attending our diabetic clinic and fulfilling our inclusion criteria, 60 patients had been diagnosed with diabetes before the earthquake and 40 after it. Table 1 shows their sociodemographic characteristics. The mean age of the first group was 56.3 $\pm$ 8.38 years, comparable to that of the second group (54.9 $\pm$ 10.02 years). There were no significant differences between these two groups in education and in the prevalence of gender. There were no differences in the use of insulin between the two diabetic patient groups.

The DTS analysis showed a difference among the two groups for the indication of the "most traumatic event." In fact, 80 % of subjects in the post-quake group but only 30 % in the pre-quake and control group indicated the earthquake. This difference was statistically significant ($p < 0.0001$; $\chi^2 = 21.78$). It is interesting that only 5 % of post-quake patients indicated diabetes as the most traumatic event, in comparison with 25 % of pre-quake patients, also in this case there was a statistically significant difference ($p = 0.0002$; $\chi^2 = 14.157$). Moreover, in the post-quake group, other forms of traumatic events were less important than the earthquake, while other traumatic events were largely reported in the pre-quake (45 %) (Table 1).

Using the DTS cutoff score for PTSD, we found that 67.5 % of patients in the post-quake group had PTSD, in comparison with 33.3 % in the pre-quake group. Here too, there was a statistically significant difference between the post-quake group and the pre-quake group ($p < 0.0001$; $\chi^2 = 21.78$) (Table 1).

PTSD was not only more prevalent but also more severe in post-quake patients than in the other group. As shown in

Table 1 Sociodemographic and clinical characteristics according to the epoch of the diagnosis

	Pre-quake patients ($n = 60$)	Post-quake patients ($n = 40$)	Comparison
Age, mean ± SD[a]	56.37 ± 8.38	54.93 ± 10.02	$p = 0.4385$ $t = -0.778$
Years of diabetes	7.02 ± 1.96	2.1 ± 0.60	$p < 0.0001$ $t = -15.380$
Females, *n* (%)[b]	26 (43.4)	20 (50)	$p = 0,3950$ $\chi^2 = 0.724$
Males	34 (56.6)	20 (50)	$p = 0.4787$ $\chi^2 = 0.502$
Primary education	5 (8.33)	2 (5)	$p = 0.5662$ $\chi^2 = 0.329$
Secondary education	42 (70)	30 (75)	$p = 0.5264$ $\chi^2 = 0.401$
Graduate degree	13 (21.66)	8 (20)	$p = 0.8622$ $\chi^2 = 0.030$
Use of insulin	5 (8.3)	1 (2.5)	$p = 0.2147$ $\chi^2 = 1.539$
DTS-traumatic event: earthquake	18 (30)	32 (80)	$p < 0.0001$ $\chi^2 = 48.505$
DTS-traumatic event: diabetes	15 (25)	2 (5)	$p = 0.0002$ $\chi^2 = 14.157$
DTS-traumatic event: other	27 (45)	6 (15)	$p < 0.0001$ $\chi^2 = 20.024$
DTS cutoff score ≥40[c]	20 (33.3)	27 (67.5)	$p < 0.0001$ $\chi^2 = 21.780$

SD standard deviation, *ns* not significant

[a] *T* test

[b] Chi-square test for the frequencies

[c] Prevalence of PTSD according to DTS cutoff score

Table 3, the mean total DTS score was 51.72 ± 26.05 in the post-quake group, 31.65 ± 22.59 in the pre-quake group, revealing a significant difference ($p = 0.0001$; $t = 4.092$).

Regarding the DTS sub-domains, there were statistically significant differences in avoidance/numbing and hyper-arousal between the post-quake and pre-quake groups (Table 3).

The analysis of results for the Brief-COPE questionnaire revealed an interesting statistical divergence for maladaptive coping. In fact, the mean score was significantly higher in the post-quake group (26.17 ± 4.64) than in the pre-quake group (22.37 ± 5.49) ($p = 0.0005$; $t = 3.602$) (Table 3).

There was no significant difference in the biological parameters of the two groups of diabetic patients (Table 3).

Table 2 Sociodemographic and clinical characteristics according to the gender

	Men ($n = 54$)	Women ($n = 46$)	Comparison
Age, mean ± SD[a]	56.41 ± 5.66	54.08 ± 11.55	$p = 0.1933$ $t = -1.310$
Years of diabetes	6.71 ± 2.89	5.70 ± 3.09	$p = 0.0947$ $t = -1.687$
Primary education *n* (%)[b]	2 (3.7)	3 (6.52)	$p = 0.5350$ $\chi^2 = 0.385$
Secondary education	36 (66.6)	26 (56.51)	$p = 0.1462$ $\chi^2 = 2.112$
Graduate degree	16 (29.62)	17 (36.95)	$p = 0.6493$ $\chi^2 = 0.207$
DTS-traumatic event: earthquake	18 (33.3)	24 (51.1)	$p = 0.0149$ $\chi^2 = 5.932$
DTS-traumatic event: diabetes	21 (38.8)	4 (8.69)	$p < 0.0001$ $\chi^2 = 23.054$
DTS-traumatic event: other	8 (14.81)	10 (27.73)	$p = 0.06$ $\chi^2 = 3.647$
DTS score ≥40[c]	16 (29.62)	27 (58.69)	$p = 0.0001$ $\chi^2 = 15.872$

SD standard deviation, *ns* not significant

[a] *T* test

[b] Chi-square test for the frequencies

[c] Prevalence of PTSD according to DTS cutoff score

Finally, Table 5 shows that maladaptive coping was the specific and only predictive psychological factor for PTSD in the post-quake group only ($p = 0.006$; OR 1.682).

Gender differences

Table 2 lists the mean age of males and female groups was 56.4 (SD = 5.6) and 54 (SD = 11.5) years, respectively, with no significant difference, such as in the level of education (Table 2).

As regards a cutoff score of 40 to establish a PTSD condition, a significant difference ($p = 0.0001$; $\chi^2 = 15.872$) was observed between men and women: 29.6 % (16/54) and 58.7 % (27/46), respectively (Table 3).

When we observed the most traumatic event in the two groups, 33.3 % (18/54) in the male group and 51.1 % (24/46) in the female group indicated the earthquake. This comparison indicated a significant difference ($p = 0.01$; $\chi^2 = 5.932$); on the other hand, 38.8 % (21/54) of males and 8.7 % (4/46) of females indicate diabetes as the most traumatic experience. Also in this case, there was a remarkable difference between the two groups ($p < 0.0001$; $\chi^2 = 23.054$).

Table 3 Psychological and biological aspects in pre-quake and in post-quake patients

	Pre-quake patients Mean ± SD[a]	Post-quake patients Mean ± SD[a]	*T* test comparison
DTS			
Total	31.65 ± 22.59	51.72 ± 26.05	$p = 0.0001$ $t = 4.092$
Intrusion	11.1 ± 9.23	14.75 ± 9.18	$p = 0.0551$ $t = 1.941$
Avoidance/ numbing	10.1 ± 8.51	17.05 ± 13.04	$p = 0.0017$ $t = 3.228$
Hyperarousal	10.62 ± 8.48	20.27 ± 9.56	$p < 0.0001$ $t = 5.297$
Brief-COPE			
Adaptive coping	41 ± 9.29	43.15 ± 7.64	$p = 0.2274$ $t = 1.215$
Maladaptive coping	22.37 ± 5.49	26.17 ± 4.64	$p = 0.0005$ $t = 3.602$
BMI	29.11 ± 6.20	28.86 ± 6.19	$p = 0.8437$ $t = -0.198$
Blood glucose (mg/dl)	160.46 ± 50.72	159.07 ± 60.41	$p = 0.9013$ $t = -0.124$
HbA1c (%, mmol/mol)	7.54 ± 1.87 59.19 ± 20.24	8.14 ± 2.35 65.01 ± 25.68	$p = 0.1790$ $t = 1.353$ $p = 0.2093$ $t = 1.264$
Diastolic blood pressure (mmHg)	81.53 ± 11.43	78.23 ± 12.36	$p = 0.1741$ $t = -1.369$
Systolic blood pressure	130.76 ± 19.34	127.05 ± 22.84	$p = 0.3844$ $t = -0.874$

[a] Student's *T* test for non-matched data and assuming an equal variance

Table 4 Psychological and biological aspects in male and female diabetic patients

	Men Mean ± SD[a]	Women Mean ± SD[a]	*T* test comparison
DTS			
Total	31.65 ± 23.06	53.50 ± 27.01	$p < 0.0001$ $t = 4.364$
Intrusion	9.70 ± 8.23	17.17 ± 9.33	$p < 0.0001$ $t = 4.254$
Avoidance/ numbing	10.26 ± 9.70	17.79 ± 12.09	$p = 0.0008$ $t = 3.455$
Hyperarousal	11.68 ± 8.92	18.94 ± 11.12	$p = 0.0005$ $t = -3.622$
Brief-COPE			
Adaptive coping	41.46 ± 9.31	45.20 ± 7.71	$p = 0.07$ $p = 1.866$
Maladaptive coping	23.63 ± 5.89	24.38 ± 4.95	$p = 0.5705$ $t = 0.570$
BMI	29.95 ± 6.13	27.99 ± 6.10	$p = 0.1135$ $t = -0.1135$
Blood glucose (mg/dl)	159.53 ± 57.13	160.25 ± 52.54	$p = 0.9482$ $t = 0.065$
HbA1c (%, mmol/mol)	7.67 ± 1.77 60.34 ± 19.35	8.12 ± 2.39 64.02 ± 26.07	$p = 0.2831$ $t = 1.079$ $p = 0.4233$ $t = 0.804$
Diastolic blood pressure (mmHg)	83.33 ± 10.46	76 ± 12.42	$p = 0.0018$ $t = -3.204$
Systolic blood pressure	134.66 ± 20.30	122.66 ± 20.86	$p = 0.009$ $t = -2.667$

[a] Student's *T* test for non-matched data and assuming an equal variance

Another statistical difference was found in the means of DTS total score: 31.65 (SD = 23.06) in males and 53.5 (27.01) in females ($p < 0.0001$; $t = 4.364$). Moreover, we found differences between males and females in symptoms of PTSD such as intrusion, avoidance/numbing and hyperarousal (Table 4).

Biological parameters are compared in Table 4, but the only statistically significant difference was in the values of blood pressure (Table 5).

Univariate logistic regression showed that only in males, coping strategies had an influence on PTSD, both adaptive and maladaptive coping: the first one in protective way ($p = 0.01$; OR 0.87) and the second one with a predictive aspect respect to PTSD ($p = 0.007$; OR 1.25) (Table 6).

Table 5 Univariate logistic regression among coping strategies, years of diabetes and age on PTSD in pre- and post-quake patients

	PTSD[a] OR; 95 % CI (*p*)	
	Pre-quake patients	Post-quake patients
Adaptive coping	0.98; 0.90–1.05 (0.6)	1.063; 0.88–1.27 (0.5)
Maladaptive coping	1.061; 0.93–1.20 (0.4)	1.682; 1.15–2.45 (0.006)
Years of diabetes	0.93; 0.85–1.01 (0.1)	0.431; 0.12–1.49 (0.16)
Age	1.02; 0.94–1.10 (0.6)	0.931; 0.84–1.02 (0.15)

OR odds ratio, *CI* confidence interval

[a] PTSD was evaluated according to DTS cutoff score

Table 6 Univariate logistic regression among coping strategies, years of diabetes and age on PTSD in women and men

	PTSD[a] OR; 95 % CI (*p*)	
	Women	Men
Adaptive coping	1.0; 0.9–1.18 (0.4)	0.87; 0.79–0.97 (0.01)
Maladaptive coping	1.1; 0.94–1.38 (0.1)	1.25; 1.06–1.48 (0.007)
Years of diabetes	0.84; 0.67–1.0 (0.13)	0.97; 0.89–1.05 (0.4)
Age	0.99; 0.93–1.06 (0.85)	0.98; 0.86–1.10 (0.7)

OR odds ratio, *CI* confidence interval

[a] PTSD was evaluated according to DTS cutoff score

Discussion

According to our primary hypothesis, these results demonstrate that there is a strong link between diabetes and PTSD in patients diagnosed with diabetes after the earthquake. For these patients, the natural disaster was the most traumatic event in their life, and the severity of their post-traumatic symptoms was higher than in pre-quake patients. In fact, we observed that the earthquake was not a significant psycho-traumatic event for the patients with pre-quake diabetes.

In patients diagnosed before April 6, 2009, post-traumatic syndrome has been of minor importance and in line with other studies on local population [15, 39] or after other natural catastrophes [17, 40]. In other words, only the newly diagnosed diabetic patients (post-quake group) were seriously affected by PTSD after the earthquake. Hence, the most striking result was undoubtedly the high prevalence and greater severity of PTSD in people who developed diabetes after the earthquake.

We could suppose that the recent diagnosis of diabetes had affected the mental health of these patients, but regression analysis related to the impact of duration of diabetes on PTSD and the capacity to discriminate of Davidson Trauma Scale did not confirm this hypothesis [36].

It cannot therefore be excluded that in some patients the exacerbation of PTSD after the earthquake had a role in the earlier development of diabetes. In this case, PTSD could be considered as one of the risk factors for diabetes and also a comorbidity factor.

In fact, different studies state that chronic stress and PTSD could be predictive of a metabolic disorder such as diabetes. [21, 27, 41–43]. The possible diabetogenic effect of post-traumatic stress is due to the dysregulation of cortisol or catecholamines during the hyperactivation of the HPA and the autonomous nervous system [6, 21, 44, 45].

Nevertheless, we did not found differences in our two groups of patients in the indicators of diabetes and its control: blood glucose and HbA1c [24].

Moreover, our findings revealed for the first time another important aspect. After a traumatic event, diabetic women develop PTSD more often than men.

It is known that in the general population and also in the local population, PTSD is more present in women than in the men [2, 3], but in a particular clinical population such as diabetic patients, this evidence was still unknown.

Women who were the subject of our investigation showed higher PTSD levels. It is likely that women had more negative thoughts with respect to stressful events with greater implications or traumatic memory [46].

In this case, in our female group, PTSD adds to the severe condition of chronic pathologies such as diabetes. Women were more affected by avoidance and numbing to demonstrate the pervasive effect of trauma, but they also revealed higher levels of hyperarousal symptoms that could be explained through the various somatic correlates of post-traumatic stress [9]. In this dramatic and psycho-pathological situation, we may suppose that women show many problems related to glycaemic control, but our results did not support this aspect [47]. In fact, diabetic females did not differ from males with regards to diabetes indicators (BMI, glycaemia and glycated hemoglobin). Nevertheless, we can validate our second hypothesis regarding gender differences in PTSD in diabetic people.

Another important aspect to strengthen the higher prevalence and severity of PTSD in diabetic women regards the causes of trauma. Women reported the earthquake as the most traumatic event, whereas men reported diabetes. Men give less importance to natural catastrophes; on the other hand, they consider chronic pathologies more dangerous and disabling. It may seem that women are more focused on negative collective events, whereas men are more concerned with negative personal health problems with a possible comorbidity of adjustment disorder.

These differences that we found in the severity and prevalence of PTSD in patient newly diagnosed and in women patients could be explained by personal characteristics, such as use of coping strategies [48–50]. In fact, our data revealed that in the patients diagnosed post-quake, maladaptive coping played a fundamental role and it was partially predictive of the post-traumatic syndrome. In the pre-quake groups, where PTSD was less evident, maladaptive coping had no significant impact on post-traumatic stress. In this group, we could suppose that the coping skills are more efficacies to front traumatic stress for a quickly reason: These patients received from more time the clinical care and the medical support by physicians and nurses for their metabolic disease. The first crisis due to diabetes diagnosis was adequately supported by care

and the subsequent earthquake, and the possible exacerbation of PTSD was few impacting compared to post-quake patients. Hence, from this point of view, the medical care for diabetes could be considered as a protective factor against other life stress event and the physician–patient relationship could play an important role for an improvement of the coping strategies.

On the contrary, the post-quake patients were more vulnerable to PTSD for the negative effect of maladaptive coping, and for this reason, it is necessary to implement the care in these subjects also for the psychological aspects.

Then, we made an analysis regarding the use of coping strategies in men and women; we noticed that only in male group there was a double action of coping strategies, at the same time in protective and predictive terms. In males, there was a possible attempt of response to trauma, with the recourse to positive and negative mechanisms of reaction linked to PTSD. In women, where PTSD is more pervasive, it is likely that are activated responses of seclusion that characterize the depressive feeling due to a collective trauma.

Limitations

The first limit is represented by the low number of sample subjects concerning a specific local population, and an extension of these data on other population after natural disaster is necessary.

The second concerns the observational design of the study that obviously omits the clinical history especially for the diabetic patients newly diagnosed. In this regard, it is lacking the assessment of past psychological symptoms, as anxiety or mood disorders such as information about hormonal patterns related to the physiology of the HPA axis. An accurate assessment of these aspects in longitudinal way will be an object of future investigations.

Conclusions

Our results revealed greater levels of PTSD in post-quake patients than in pre-quake confirming the primary hypothesis of this study about the complex psychoneuroendocrinological link among stressful life events, trauma and diabetes.

Moreover, these evidences have highlighted, as expected and according to our secondary hypothesis higher levels and a major prevalence of PTSD in women compared to men.

Therefore, we suggest that PTSD may be considered as an important comorbidity factor in newly diagnosed patients and in diabetic women after a traumatic event. On the whole, in new diabetic patients and particularly in women, psychological support seems to be very important to help them react to both PTSD and diabetes and to help them improve their coping skills.

Acknowledgments Authors receive the fund from Italian Ministry of University (MIUR-PRIN and FIRB Grants).

Conflict of interest Professor Jannini is speaker and consultant of Janseen, Bayer, Lilly, Pfizer and Menarini. Giacomo Ciocca, Eleonora Carosa, Maria Stornelli, Erika Limoncin, Giovanni L. Gravina, Rossella Iannarelli, Alessandra Sperandio, Stefania Di Sante, Andrea Lenzi and Davide Lauro declare that they have no conflicts of interest.

Human and animal rights disclosure All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed consent disclosure Informed consent was obtained from all patients for being included in the study.

References

1. Stratta P, de Cataldo S, Bonanni R, Valenti M, Masedu F, Rossi A (2012) Mental health in L'Aquila after the earthquake. Annali dell'Istituto superiore di sanita 48(2):132–137
2. Sanità ISd (2013) Risultati dello studio CoMeTeS (Conseguenze a Medio Termine del Sisma): stato di salute della popolazione dopo il terremoto del 2009 in Abruzzo. Rapporti ISTISAN 13/2
3. Dell'osso L, Carmassi C, Massimetti G, Stratta P, Riccardi I, Capanna C, Akiskal KK, Akiskal HS, Rossi A (2012) Age, gender and epicenter proximity effects on post-traumatic stress symptoms in L'Aquila 2009 earthquake survivors. J Affect Disord 146(2):174–180
4. Kamoi K, Tanaka M, Ikarashi T, Miyakoshi M (2006) Effect of the 2004 mid niigata prefecture earthquake on patients with endocrine disorders. Endocr J 53(4):511–521
5. Laryea G, Arnett MG, Muglia LJ (2012) Behavioral studies and genetic alterations in corticotropin-releasing hormone (CRH) neurocircuitry insights into human psychiatric disorders. Behav Sci 2(2):135–171
6. Sherin JE, Nemeroff CB (2011) Post-traumatic stress disorder: the neurobiological impact of psychological trauma. Dialogues Clin Neurosci 13(3):263–278
7. Bryant RA (2003) Acute stress reactions: can biological responses predict posttraumatic stress disorder? CNS Spectr 8(9):668–674
8. APA (2000) Diagnostic and statistical manual of mental disorders, 4th edn, Text revision
9. Boscarino JA (2004) Posttraumatic stress disorder and physical illness: results from clinical and epidemiologic studies. Ann N Y Acad Sci 1032:141–153
10. Carmassi C, Akiskal HS, Yong SS, Stratta P, Calderani E, Massimetti E, Akiskal KK, Rossi A, Dell'Osso L (2013) Posttraumatic stress disorder in DSM-5: estimates of prevalence and criteria comparison versus DSM-IV-TR in a non-clinical sample of earthquake survivors. J Affect Disord 151(3):843–848
11. Carmassi C, Akiskal HS, Bessonov D, Massimetti G, Calderani E, Stratta P, Rossi A, Dell'Osso L (2014) Gender differences in DSM-5 versus DSM-IV-TR PTSD prevalence and criteria comparison among 512 survivors to the L'Aquila earthquake. J Affect Disord 160:55–61

12. Pollice R, Bianchini V, di Mauro S, Mazza M, Verni L, Roncone R, Casacchia M (2012) Cognitive function and clinical symptoms in first-episode psychosis and chronic schizophrenia before and after the 2009 L'Aquila earthquake. Early Interv Psychiatry 6(2):153–158
13. Dell OL, Carmassi C, Massimetti G, Conversano C, Daneluzzo E, Riccardi I, Stratta P, Rossi A (2011) Impact of traumatic loss on post-traumatic spectrum symptoms in high school students after the L'Aquila 2009 earthquake in Italy. J Affect Disord 134(1–3):59–64
14. Carta G, D'Alfonso A, Colagrande I, Catana P, Casacchia M, Patacchiola F (2012) Post-earthquake birth-rate evaluation using the brief cope. J Maternal-Fetal Neonatal Med 25(11):2411–2414
15. Dell'Osso L, Carmassi C, Massimetti G, Daneluzzo E, Di Tommaso S, Rossi A (2011) Full and partial PTSD among young adult survivors 10 months after the L'Aquila 2009 earthquake: gender differences. J Affect Disord 131(1–3):79–83
16. Gigantesco A, Mirante N, Granchelli C, Diodati G, Cofini V, Mancini C, Carbonelli A, Tarolla E, Minardi V, Salmaso S, D'Argenio P (2013) Psychopathological chronic sequelae of the 2009 earthquake in L'Aquila. Italy. J Affect Disord 148(2–3):265–271
17. Feder A, Ahmad S, Lee EJ, Morgan JE, Singh R, Smith BW, Southwick SM, Charney DS (2013) Coping and PTSD symptoms in Pakistani earthquake survivors: purpose in life, religious coping and social support. J Affect Disord 147(1–3):156–163
18. Lazarus RS (1993) Coping theory and research: past, present, and future. Psychosom Med 55(3):234–247
19. Carver CS, Scheier MF, Weintraub JK (1989) Assessing coping strategies: a theoretically based approach. J Pers Soc Psychol 56(2):267–283
20. Taylor R (2013) Type 2 diabetes: etiology and reversibility. Diabetes Care 36(4):1047–1055
21. Heppner PS, Crawford EF, Haji UA, Afari N, Hauger RL, Dashevsky BA, Horn PS, Nunnink SE, Baker DG (2009) The association of posttraumatic stress disorder and metabolic syndrome: a study of increased health risk in veterans. BMC Med 7:1
22. Boyko EJ, Jacobson IG, Smith B, Ryan MA, Hooper TI, Amoroso PJ, Gackstetter GD, Barrett-Connor E, Smith TC (2010) Risk of diabetes in US military service members in relation to combat deployment and mental health. Diabetes Care 33(8):1771–1777
23. Marcovecchio ML, Chiarelli F (2012) The effects of acute and chronic stress on diabetes control. Sci signal 5 (247):pt10
24. Trief PM, Ouimette P, Wade M, Shanahan P, Weinstock RS (2006) Post-traumatic stress disorder and diabetes: co-morbidity and outcomes in a male veterans sample. J Behav Med 29(5):411–418
25. Trief PM, Morin PC, Izquierdo R, Teresi J, Eimicke JP, Goland R, Starren J, Shea S, Weinstock RS (2006) Depression and glycemic control in elderly ethnically diverse patients with diabetes: the IDEATel project. Diabetes Care 29(4):830–835
26. Bartoli F, Carra G, Crocamo C, Carretta D, Clerici M (2013) Metabolic syndrome in people suffering from posttraumatic stress disorder: a systematic review and meta-analysis. Metab Syndr Relat Disord 11(5):301–308
27. Lukaschek K, Baumert J, Kruse J, Emeny RT, Lacruz ME, Huth C, Thorand B, Holle R, Rathmann W, Meisinger C, Ladwig KH (2013) Relationship between posttraumatic stress disorder and type 2 diabetes in a population-based cross-sectional study with 2970 participants. J Psychosom Res 74(4):340–345
28. Charney DS (2004) Psychobiological mechanisms of resilience and vulnerability: implications for successful adaptation to extreme stress. Am J Psychiatry 161(2):195–216
29. Rotella F, Cresci B, Monami M, Aletti V, Andreoli V, Ambrosio ML, Ricca V, Dicembrini I, Mannucci E (2012) Are psychopathological features relevant predictors of glucose control in patients with type 2 diabetes? A prospective study. Acta Diabetol 49(suppl.1):179–184
30. Furuya M, Hayashino Y, Tsujii S, Ishii H, Fukuhara S (2013) Comparative validity of the WHO-5 Well-Being Index and two-question instrument for screening depressive symptoms in patients with type 2 diabetes. Acta Diabetol 50(2):117–121
31. Ceretta LB, Reus GZ, Abelaira HM, Jornada LK, Schwalm MT, Hoepers NJ, Tomazzi CD, Gulbis KG, Ceretta RA, Quevedo J (2012) Increased prevalence of mood disorders and suicidal ideation in type 2 diabetic patients. Acta Diabetol 49(Suppl 1):S227–S234
32. Trento M, Raballo M, Trevisan M, Sicuro J, Passera P, Cirio L, Charrier L, Cavallo F, Porta M (2012) A cross-sectional survey of depression, anxiety, and cognitive function in patients with type 2 diabetes. Acta Diabetol 49(3):199–203
33. Ditlevsen DN, Elklit A (2012) Gender, trauma type, and PTSD prevalence: a re-analysis of 18 nordic convenience samples. Ann Gen Psychiatry 11(1):26. doi:10.1186/1744-859X-11-26
34. Gendelman N, Snell-Bergeon JK, McFann K, Kinney G, Paul Wadwa R, Bishop F, Rewers M, Maahs DM (2009) Prevalence and correlates of depression in individuals with and without type 1 diabetes. Diabetes Care 32(4):575–579
35. Roy T, Lloyd CE (2012) Epidemiology of depression and diabetes: a systematic review. J Affect Disord 142(Suppl):S8–21
36. Davidson JR, Book SW, Colket JT, Tupler LA, Roth S, David D, Hertzberg M, Mellman T, Beckham JC, Smith RD, Davison RM, Katz R, Feldman ME (1997) Assessment of a new self-rating scale for post-traumatic stress disorder. Psychol Med 27(1):153–160
37. Carver CS (1997) You want to measure coping but your protocol's too long: consider the brief COPE. Int J Behav Med 4(1):92–100
38. Meyer B (2001) Coping with severe mental illness: relation of the Brief COPE, with symptoms, functioning, and well-being. J Psychopathol Behav Assess 23(4):265–277
39. Stratta P, Rossi A (2013) Misreporting of suicide after the L'Aquila earthquake. Br Med J 346:f3179. doi:10.1136/bmj.f3179
40. Neria Y, Nandi A, Galea S (2008) Post-traumatic stress disorder following disasters: a systematic review. Psychol Med 38(4):467–480. doi:10.1017/S0033291707001353
41. Agyemang C, Goosen S, Anujuo K, Ogedegbe G (2012) Relationship between post-traumatic stress disorder and diabetes among 105 180 asylum seekers in the Netherlands. Eur J Public Health 22(5):658–662
42. Nishina M, Nishina K, Ohira T, Makino K, Iso H (2011) Associations of psychological distress with metabolic syndrome among Japanese urban residents. J Atheroscler Thromb 18(5):396–402
43. Goodwin RD, Davidson JR (2005) Self-reported diabetes and posttraumatic stress disorder among adults in the community. Prev Med 40(5):570–574
44. Chrousos GP (2000) The role of stress and the hypothalamic–pituitary–adrenal axis in the pathogenesis of the metabolic syndrome: neuro-endocrine and target tissue-related causes. Int J Obes Related Metabolic Disord J Int Assoc Study Obes 24(Suppl 2):S50–S55
45. Anagnostis P, Athyros VG, Tziomalos K, Karagiannis A, Mikhailidis DP (2009) Clinical review: the pathogenetic role of cortisol in the metabolic syndrome: a hypothesis. J Clin Endocrinol Metab 94(8):2692–2701
46. Zetsche U, Ehring T, Ehlers A (2009) The effects of rumination on mood and intrusive memories after exposure to traumatic material: an experimental study. J Behav Ther Exp Psychiatry 40(4):499–514

47. Gois C, Dias VV, Raposo JF, do Carmo I, Barbosa A (2012) Vulnerability to stress, anxiety and depressive symptoms and metabolic control in type 2 diabetes. BMC Res Notes 5:271
48. Arikan G, Karanci N (2012) Attachment and coping as facilitators of posttraumatic growth in Turkish university students experiencing traumatic events. J Trauma Dissociation 13(2):209–225
49. Perez Benitez CI, Zlotnick C, Dyck I, Stout R, Angert E, Weisberg R, Keller M (2012) Predictors of the long-term course of comorbid PTSD: a naturalistic prospective study. Int J Psychiatry Clin Practice. doi:10.3109/13651501.2012.667113
50. Oflaz F, Hatipoglu S, Aydin H (2008) Effectiveness of psychoeducation intervention on post-traumatic stress disorder and coping styles of earthquake survivors. J Clin Nurs 17(5):677–687