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RESEARCHES

COVID-19: role of resilience on the psychological impact of lockdown in liver transplant transitional candidates and recipients

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Abstract. – The coronavirus disease 2019 (COVID-19) pandemic and the necessary spreading control measures implemented by the governments have induced drastic changes in daily life. The reduction in mobility and strict social contact limitations are posing a great challenge, particularly for the adolescents. The purpose of this study is to investigate the psychological and emotional impact of lockdown and their relationship with resilience, on adolescents and young adults listed for liver transplant or liver trans-plant recipient. Social and demographic variables of subjects (n=66) were collected and the analyses were based on the Depression Anxiety and Stress Scales (DASS-21), and Connor-Davidson Resilience Scale (CD-RISC 25), exploring the following areas: emotional states of depression, anxiety and stress; and resilience factors. A correlation between the measured degrees of depression/anxiety and resilience was evaluated by Pearson's correlation coefficient and linear regression models. The results showed a significant correlation between subscales: DASS depression/anxiety (r^2=0.62) depression/stress (r^2=0.65) CD-RISC commitment/optimism (r^2=0.71). The total score of DAAS depression/anxiety/stress scales significantly diminished at the increasing of CD-RISC total score. The inverse correlation between CD-RISC and DAAS seems to refer to the subscale of the relationship between DAAS depression and CD-RISC (β= –0.33, P=0.006). Our findings suggest that resilience can be a protective factor for adolescent liver transplant recipients and liver transplant candidates in mitigating the onset of negative psychological symptoms correlated with the pandemic.

Key words: Transplant liver; transitional; COVID-19; psychological impact of home confinement.

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Introduction

On February 11th, 2020, the World Health Organization has named coronavirus disease 2019 (COVID-19) the novel infectious disease that had been identified in China and that rapidly spread worldwide leading to a pandemic. Since February 20th, Lombardy, a North Italian region, has been the epicentre of the first wave of the Italian outbreak of COVID-19, especially in the Province of Bergamo. Bergamo has been the town at the centre of the storm during the epidemic, with 14,865 reported cases by 21 July 2020 and 2300 deaths (N. Perico *et al*., 2020; Senni, 2020). Starting from the end of February 2020, the rates of infected patients have dramatically and steeply increased, forcing an unexpected over boarding the Hospitals in the Bergamo area (Buoro *et al*., 2020; Fagiuoli *et al*., 2020; L. Perico *et al*., 2020). By May 5th 2020, thanks to the urgent containment measured adopted by the Italian government, the curve of daily infections has sharply fallen (Buoro *et al*., 2020; Fagiuoli *et al*., 2020; L. Perico *et al*., 2020).

However, the fear for the pandemic and the tight containment measures adopted by the Italian government such as lockdown and social distancing, have led to drastic changes of adolescents and young adults daily life. Adolescence is a period of self-centeredness, a change from realistic to more abstract thoughts and a time for risk experiments, which is equal among all teenagers, including those with a chronic disease (Kelly & Wray, 2014). In reaching the developmental goals typical of adolescence, teenagers with chronic disease are at an additional disadvantage, since they must concurrently control symptoms and undergo limitations on social interactions. Lockdown and social distancing, although well recognized necessary safety measure for the pandemic, may result in negative psychological effects in adolescents: depression, anxiety, stress, post-traumatic stress disorder may arise or even worsen in healthy adolescents and adolescents with chronic illness (Silva *et al*., 2020). Adolescents liver transplant recipient or listed for transplantation are in a critical period of the development and at the same time they are dealing with chronic illness. Many studies demonstrate an association between mental health disorders and organ transplantation, with adolescent organ transplants recipients being five more time likely to experience anxiety and depression than the general population (Bush *et al*., 2021). It has been shown that young patients with chronic liver disease and liver transplantation have a high level of anxiety and depression, both strongly associated to patient's belief regarding their illness and treatment (Hames *et al*., 2016). Moreover 74.0% of adolescent transplant recipients in a suburban transplant clinic have been screened and it has been found mild to moderate anxiety in 46.4% and depression in 35.7% of the patients (Bush *et al*., 2021). Psychological reactions such as anxiety and depression may be exacerbated from COVID-19 pandemic: a special

care and a particular attention in order to preserve their mental health seem to be mostly needed. Stressful events, such as an epidemic outbreak, create an adverse environment that can predispose individuals to negative emotional response such as depression, anxiety and stress symptoms (Zhou *et al*., 2020). Emotional resilience lies in the same adverse environment and it is defined as "*the personal ability that enable one to constructively adapt to difficult circumstances and to generate positive emotions when facing negative events*" (Q. Zhang *et al*., 2020). Indeed, resilience can be seen as a measure of stress coping ability and it could represent a major factor in managing depression, anxiety and stress reactions (Connor & Davidson, 2003). A psychological research regarding adolescents in the context of adverse events has shown that resilience mediated the relationship between negative life events and depressive symptoms, hypothesizing that it can act as a protective factor for adolescents in mitigating the negative effects of adverse events (Ran *et al*., 2020; Q. Zhang *et al*., 2020).

At the Papa Giovanni XXIII Hospital in Bergamo, the consequence of COVID-19 had been dramatic and induced structural and logistical reorganizations in all clinical activities (Buoro *et al*., 2020). Among them, the transitional care unit for liver transplanted patients had been operating online, administering online questionnaires to evaluate the presence of depressive, anxiety and stress symptoms together with a resilience scale. In the context of the transitional care unit, monitoring the mental health of young patients with chronic illness is paramount, as several adverse psychological symptoms are related with non-adherence and poorer health outcome (Hames *et al*., 2016; Watson, 2000). The purpose of this study is to investigate the psychological and emotional impact of lockdown on adolescents and young adults listed for liver transplant of liver transplant recipient and to analyse the possible correlation of negative psychological symptoms such as depression, anxiety, stress and the level of resilience. Our working hypothesis is that high levels of resilience can act as protective factors for the onset of COVID-19 related depressive, anxiety and stress symptoms in adolescent liver transplant recipient or listed for transplant.

Materials and methods

Participants

A cross-sectional study has been carried out by means of an online survey and structural questionnaire starting on March 10th 2020. All patients included in the database of the ASST-PG23 Transplant Centre, with the criteria of being born between 1999 and 2003 were contacted by telephone. The total sample resulted in 172 patients, of whom 23 resulted deceased.

Informed consent of patients was collected verbally. The institutional Review Board provided approval for the study (257/2020, 13/02/2020).

The initial telephone contact allowed us to reach 99 patients which answered and gave their consent to participated at the study: amongst the 50 patients who did not participate, 8 refused, 15 telephone contacts were not reachable, 27 resulted lost to follow-up. Patients who approved to participated at the study received the link via email to fill the online questionnaires, and 66 questionnaires were properly completed. Thus, a total of sixty-six patients were involved in the study (34 females and 32 males; mean age 18.5 years).

Materials

A 5-Point Likert scale was developed aimed at investigating the concerns of the participants and their perception on how the pandemic could jeopardize their life project and consequently impact their psychological condition. Participants were asked to rate the statements, ranging from 0 (never) to 5 (always).

Depression and anxiety were assessed by the Depression, Anxiety and Stress Scale-21 Items (DASS-21). The DASS-21 is a simple and well-developed tool for measuring the emotional states of depression, anxiety and stress; It has three self-report scales, each of the theme contains 7 items, divided into subscales. Participants had to rate on a 4-point scale whether the reported situation was reflecting their previous week. The 7 items of Depression DASS-21 assess dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia. The Anxiety scale assesses autonomic arousal, skeletal muscle effects, situational anxiety, and subjective experience of anxious affect. The Stress scale is sensitive to levels of chronic non-specific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset/agitated, irritable/over-reactive and impatient. Scores for Depression, Anxiety and Stress are calculated by adding the scores for the relevant items. The DASS-21 is based on a dimensional rather than a categorical conception of psychological disorder. The assumption on which the DASS-21 development was based (and which was confirmed by the research data) is that the differences between the depression, the anxiety, and the stress experienced by normal subjects and the clinically disturbed, are essentially differences of degree. The DASS-21 therefore has no direct implications for the allocation of patients to discrete diagnostic categories postulated in classificatory systems such as the DSM and ICD. A study on the psychometric properties of the Italian version of the DASS-21 showed good internal consistency and good temporal stability of the measure (Bottesi *et al.*, 2015). The total score of the scales and subscale were

obtained and higher score is related to high level of depression, anxiety and stress. It has been used the DASS-21 for its specificity to investigate anxiety, depression and stress and because its rapid administration, moreover the DASS-21 has been frequently used in research studies with children and adolescents (C. Zhang *et al*., 2020).

The Connor-Davidson resilience scale (CD-RISC) is a reliable and self-rated instrument aimed to evaluate one's ability to manage stress, to cope with adverse experiences, and to assess treatment response. Since CD-RISC has good psychometric properties (Connor & Davidson, 2003), it has been used for the assessment of resilience and is ranked in the top three among fifteen measures proposed to assess resilience (Windle *et al*., 2011). It has 25 items and each item has a 5-points range of responses, with a minimum score of 0 and a maximum score of 4. This scale was built (by psychiatrists Kathryn M. Connor and Jonathan R.T. Davidson) with the intention of produce a reliable and validated tool for investigating the level of resilience of people with post-traumatic stress disorder; subsequently it has decided to expand the use of this scale to the general population; it can also be utilized to detect changes in resilience levels following specific pharmacological or non-pharmacological treatments.

The scale consists of 25 items, which investigate the following five factors: i) personal competence and tenacity (items 4-5-6-7-8-10-11-17); ii) self-confidence and management of negative emotions (items 12-15-16-21-23-24); iii) positive acceptance of change and safe relationships (items 1-2-13-18-22-25); iv) self-control skills (items 14-19-20); v) spiritual influences (items 3-9).

The total score on the scale ranges from 0 to 100, the higher the score, the greater the person's degree of resilience. The CD-RISC total score ranges from 0-100, indicating lowest resilience (0-73), poor resilience (74-82), moderate resilience (83-90) and greater resilience (91-100). The CD-RISC has been showing a good internal consistency (Cronbach's α=0.89), and a high level of agreement (r=0.87). The Connor-Davidson resilience scale (CD-RISC 25) with 25 items has been translated and validated in Italian by Comoretto (2006).

Statistical analysis

A descriptive analysis for social and demographic variables of participants was performed: continuous variables (scores from 5-points Likert scale, DASS-21 and CD-RISC) were expressed as mean and standard deviation (SD) and median and interquartile range (IQR), categorical variables (gender, clinical status, education, profession and positive case in family) were expressed as absolute counts and percentages.

Pearson's correlation coefficient was adopted for measuring the

statistical relationship between the CD-RISC subscales scores and DASS-21 subscales scores. Linear regression models were fitted to describe the relationship between CD-RISC score and DASS-21 subscales scores, overall and stratifying by gender. The regression lines (and the corresponding β coefficients) were reported. All statistical analyses were performed using Stata Software, release 16 (StataCorp LP, College Station TX, USA). All tests were two-sided and a P-value <0.05 was considered significant.

Demographic and general information

Social and demographic variables of subjects were collected, including age, gender, clinical status, degree level, activities and whether they had confirmed cases in their family of COVID-19. Among the 66 participants, 64 (97%) were liver transplant recipient whilst 2 were listed for liver transplant, 84.8% were students (33 with a secondary school diploma, 32 with high school diploma and one graduated) and 15% were actively working. Fifty-nine (89.4%) reported no SARS-CoV-2 infections among their relatives during the pandemic, 5 reported COVID-19 cases in their families, and 2 were not aware of it (Table 1).

5-points Likert scale reported previous mild worrying to be infected (M=2.7, SD=1.2), currently very mild worrying to be infected (M=2.4, SD=1.1), currently worrying for the future (M=2.7, SD=1.4), thinking's that

Table 1. Social and demographic characteristics of the study group.

	Total N=66 n (%)
Age, mean (SD)	18.5 (1.2)
Gender	
Male	32 (48.5%)
Female	34 (51.5%)
Clinical status	
Liver transplant recipient	64 (97.0%)
Listed for liver transplant	2 (3.0%)
Education	
Degree	1 (1.5%)
High School	32 (48.5%)
Secondary	33 (50.0%)
Profession	
Student	56 (84.8%)
Worker	10 (15%)
Positive case in family	
Yes	5 (7.6%)
No	59 (89.4%)
Don't know	2 (3.0%)

pandemic is going to negative affect future projects (M=2.9, SD=1.3), how much pandemic had impacted the sensitivity (M=2.8, SD=1.5) and how proudly patients felt about themselves (M=2.6, SD=1.2). Overall results from 5-points Likert scale showed a mild worrying on the negative effects of pandemic on their sensitivity and their projects (Table 2).

Mean scores from DASS-21 reported an average normal score of DASS-21 depression (M=7.7; SD=8.6), mild and moderate depression symptoms were 9.1% and 9.1% respectively. Severe and extremely severe symptoms of depression are reported in 7.6% and in 3.0% respectively. Anxiety DASS-21 mean scores showed normal level of anxiety symptoms (M=3.5; SD=4.6). Normal and mild anxiety symptoms were found in 80.3% and 7.6% patients, respectively. Moderate and severe anxiety symptoms were reported in 7.6% and 4.5% respectively. Extremely severe anxiety symptoms were not reported. DASS-21 Stress scores reported an average of normal stress symptoms (M=11.8; SD=8.7); of participants reported normal and mild stress symptoms in 67.7% and 13.8% respectively; moderate and severe stress symptoms were reported by 7.7% and 10.8% respectively. Extremely severe stress symptoms were not reported (Table 3).

CD-RISC total mean scores showed low resilience (M=55.8; SD=13.8). The sub-scales presented the following scores (Table 4): i) CD-RISC: Commitment/challenge/control showed low resilience (M=16.3; SD=5.4); ii) CD-RISC: Ability to adapt to change (M=12.6; SD=3.0); iii) CD-RISC: Adaptability/flexibility (M=6.9; SD=2.2); iv) CD-RISC: Significant/purpose (M=6.5; SD=2.9); v) CD-RISC: Optimism (M=3.9; SD=1.9); vi) CD-RISC: Cognition and emotion regulation (M=3.8; SD=2.0); vii) CD-RISC: Self efficacy (M=5.2; SD=1.7).

Pearson's correlation coefficient showed a moderate correlation between each of the DASS-21 sub-scales (Table 5). Moderate correlations were also

Table 2. 5-points Likert scale: investigation of attitude and concerns about SARS-CoV-2.

On a scale of 0 (never) to 5 (always)…		
How worried were you to get infected by SARS-CoV-2?	Mean±SD Median (IQR)	2.7 (1.2) 3.0 (2.0-4.0)
How worried are you now to get infected by SARS-CoV-2?	Mean±SD Median (IQR)	2.4 (1.1) 2.0 (1.0-3.0)
How worried are you now for your future?	Mean±SD Median (IQR)	2.7 (1.4) 3.0 (2.0-4.0)
Do you think SARS-CoV-2 pandemic is going to affect your future projects?	Mean±SD Median (IQR)	2.9 (1.3) 3.0 (2.0-4.0)
How have SARS-CoV-2 impacted on your sensitivity?	Mean±SD Median (IQR)	2.8 (1.5) 3.0 (1.0-4.0)
How much proud were you about your role?	Mean±SD Median (IQR)	2.6 (1.2) 3.0 (2.0-3.0)

found between CD-RISC Commitment and all of sub-scales; a statistically significant strong correlation was found between CR-RISC Optimism and CD-RISC Commitment. Pearson's correlation coefficient between CD-RISC total score and DAAS-21 depression, anxiety stress subscales scores, reported a linear relationship (Figure 1).

When CD-RISC total score increased the DAAS-21 depression, anxiety and stress score decreased significantly ($P<0.05$). Specifically, an increase of CD-RISC total score corresponded to an average decrease of DAAS-21 depression score of 0.30 point, an average decrease of DAAS-21 anxiety score of 0.11 points and an average decrease of DAAS-21 stress of 0.16 points. As far as gender impact, our results showed that an inverse correlation is evident for females, namely in the relationship between DAAS-21 depression and CD-RISC ($\beta= –0.33$, $P=0.006$). DAAS-21 anxiety score and DAAS-21 stress score in males showed a poor correlation with CD-RISC whereas in female a decrease of score of DAAS-21 was related to a trend in increase of CD-RISC total scores although it resulted no statistically significant (Figure 2).

Table 3. DASS-2: investigation of depression, anxiety and stress symptoms.

AAS-21 score		
DAAS-21 score: depression	Mean±SD Median (IQR)	7.7 (8.6) 4.0 (2.0-10.0)
Normal (0-9)	n (%)	47 (71.2%)
Mild (10-13)		6 (9.1%)
Moderate (14-20)		6 (9.1%)
Severe (21-27)		5 (7.6%)
Extremely severe (28+)		2 (3.0%)
DAAS-21 score: anxiety	Mean±SD Median (IQR)	3.5 (4.6) 2.0 (0.0-6.0)
Normal (0-7)	n (%)	53 (80.3%)
Mild (8-9)		5 (7.6%)
Moderate (10-14)		5 (7.6%)
Severe (15-19)		3 (4.5%)
Extremely severe (20+)		0 (0.0%)
DAAS-21 score: stress	Mean±SD Median (IQR)	11.8 (8.7) 10.0 (6.0-18.0)
Normal (0-14)	n (%)	44 (67.7%)
Mild (15-18)		9 (13.8%)
Moderate (19-25)		5 (7.7%)
Severe (26-33)		7 (10.8%)
Extremely severe (34+)		0 (0.0%)
NA		1

Discussion and conclusions

Although the correlation between adolescence, resilience and COVID-19 related psychological distress is well known (Barzilay *et al*., 2020a; Connor & Davidson, 2003; Ran *et al*., 2020; Shah *et al*., 2020), to the best of our knowledge, this study is the first to examine the psychological impact of lockdown due to COVID-19 pandemic in adolescents listed for liver transplant or liver transplant recipient and the possible role of resilience as a protective factor in mitigating the onset of depression, anxiety and stress. Starting from the end of February 2020, the consequences of COVID-19 first wave have been dramatic (Senni, 2020). The rates of infected patients have dramatically and steeply increased, forcing an unexpected over boarding of hospitals in the Bergamo area (Buoro *et al*., 2020; Fagiuoli *et al*., 2020; L. Perico *et al*., 2020) and particularly for the 'Papa Giovanni XXIII' Hospital of Bergamo.

In order to face the COVID-19 pandemic and to reduce the spreading of the infectious disease, the Italian government implemented tight safe measures such as lockdown and social distancing. The reduction of mobility and limitation of the social contacts, the closure of school activities and switching to online classes has represented a major challenge for both adolescents and young adults (C. Zhang *et al*., 2020). Recent studies (Brooks *et al*., 2020; C.

Table 4. CD-RISK: level of resilience.

Connor-Davidson resilience scale (CD-RISC)		
CD-RISC total	Mean±SD Median (IQR)	55.8 (13.8) 54.0 (45.0-65.0)
Low resilience (0-73) Poor resilience (74-82) Moderate resilience (83-90) Strong resilience (91-100) NA	n (%)	56 (88.9%) 5 (7.9%) 2 (3.2%) 0 (0.0%) 3
CD-RISC: commitment/challenge/control	Mean±SD Median (IQR)	16.3 (5.4) 16.5 (12.0-20.0)
CD-RISC: ability to adapt to change	Mean±SD Median (IQR)	12.6 (3.0) 13.0 (10.5-15.0)
CD-RISC: adaptability/flexibility	Mean±SD Median (IQR)	6.9 (2.2) 7.0 (5.0-8.0)
CD-RISC: significant/purpose	Mean±SD Median (IQR)	6.5 (2.9) 6.0 (4.0-9.0)
CD-RISC: optimism	Mean±SD Median (IQR)	3.9 (1.9) 4.0 (3.0-5.0)
CD-RISC: cognition and emotion regulation	Mean±SD Median (IQR)	3.8 (2.0) 4.0 (2.0-5.0)
CD-RISC: self-efficacy	Mean±SD Median (IQR)	5.2 (1.7) 5.0 (4.0-6.0)

Table 5. Pearson's (ρ) linear correlation coefficients between DASS-21 and CD-RISC subscales.

	DAAS-depression	DAAS-anxiety	DAAS-stress	CD-RISC-commitment	CD-RISC-adaptation	CD-RISC-adaptability	CD-RISC-significant	CD-RISC-optimism	CD-RISC-emotions	CD-RISC-self-efficacy
DAAS-depression	1									
DAAS-anxiety	0.6247*	1								
DAAS-stress	0.6536*	0.6320*	1							
CD-RISC-commitment	–0.4990*	–0.2885*	–0.2377	1						
CD-RISC-adaptation	–0.2475*	–0.2101	–0.0785	0.5795*	1					
CD-RISC-adaptability	–0.3013*	–0.2760*	–0.1726	0.4210*	0.2869*	1				
CD-RISC-significant	–0.2106	–0.0951	–0.1394	0.4448*	0.3387*	0.2171	1			
CD-RISC-optimism	–0.4594*	–0.2714*	–0.3824*	0.7113*	0.5050*	0.5468*	0.3345*	1		
CD-RISC-emotions	–0.0975	–0.3618*	–0.1694	0.3035*	0.2982*	0.5064*	0.1198	0.3545*	1	
CD-RISC-self efficacy	–0.3374*	–0.2480*	–0.147	0.6395*	0.5733*	0.2396	0.4493*	0.4582*	0.1959	1

Zhang *et al*., 2020) have shown that the reduction of social interaction, lockdown restriction, difficulties to manage the lessons and home studying, substantial changes on daily life, living in *continuous* close contact with family members, with sport and leisure activities suspended, fear to be infected or to worsen the chronic medical condition, associated with boredom can undoubtedly create a dramatic psychological effects on adolescent and young adults. Although the rates of the contagions have diminished, somewhat reducing the health-related impact of the pandemic, our hypothesis is that the social restriction might led to the onset of depression, anxiety and stress, particularly in adolescence and young adults listed for liver transplant or live transplant recipient in as much they are already dealing with a chronic condition.

Adolescence is a challenging moment in life and a transitional time in which self-independence and autonomy are still developing, physical changes occur and the context of peer is paramount to allow the development a finite sense of identity (Ahola Kohut *et al*., 2017; Kelly & Wray, 2014). Nevertheless, chronic illness and transplantation during this critical time overcame the challenge presented by adolescence and can place the young person at risk of isolation from peers, making their path to independency from family members even more complicated (Kelly & Wray, 2014). An important qualitative study

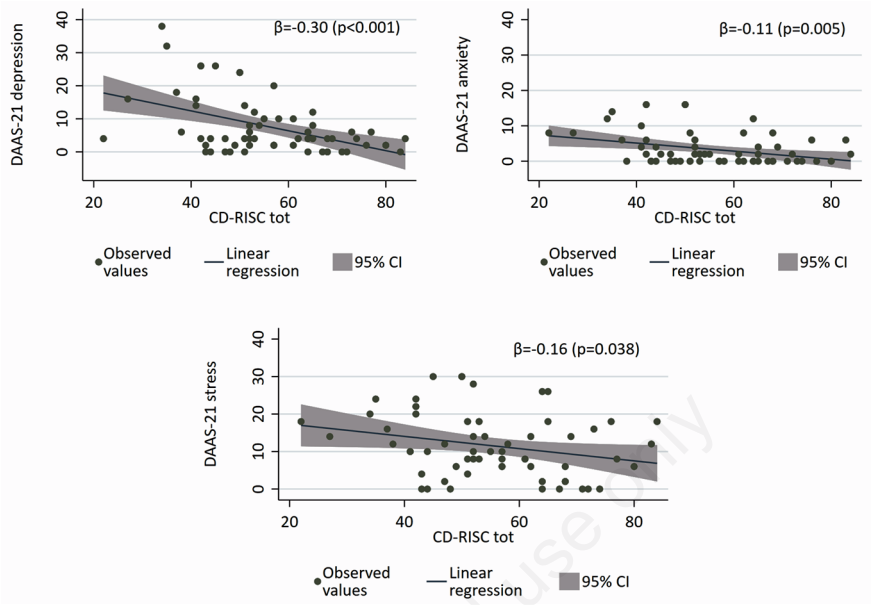

Figure 1. Linear relationship between Connor-Davidson (CD-RISC) scale total and DAAS-21 subscales score for depression, anxiety and stress.

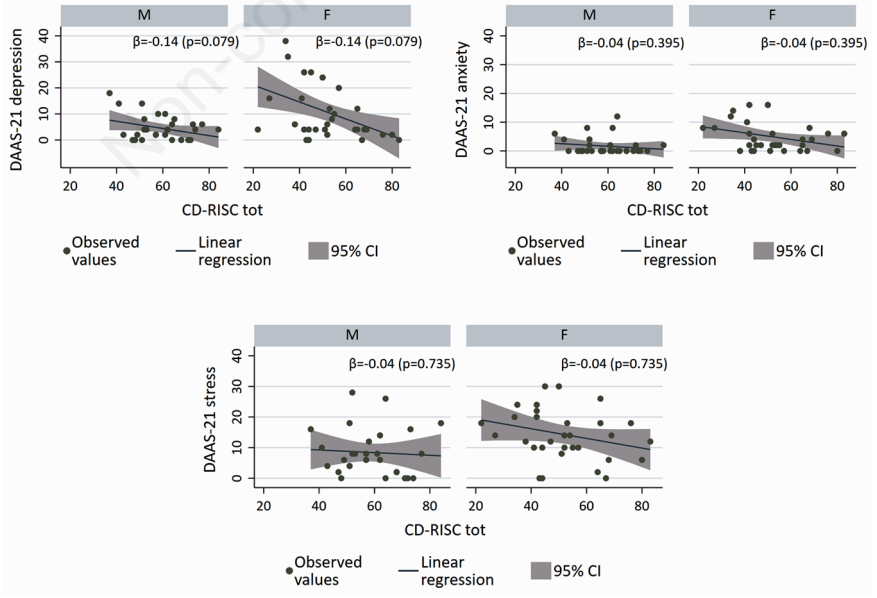

Figure 2. Linear relationship between Connor-Davidson (CD-RISC) scale total and DAAS-21 subscales score for depression, anxiety and stress stratified for gender.

conducted by Taylor *et al*. (2010) investigating the experience of adolescents living with a liver transplant, reports difficulties in relationship building, impacts on school studying, on management of medications and fatigue, on projects for the future in the context of a sense of tiredness (Fujita, 2016). Adolescents with chronic illness may suffer more as a consequence of the social distancing from their friends, as peers are particularly important in buffering the daily impact of the disease, making them feel more integrated and approved (Taylor *et al*., 2010): they feel disadvantaged in achieving their developmental goals, when coping with the management of the chronic disease (Ahola Kohut *et al*., 2017). Additionally, it has been investigated the level of resilience on participants: since resilience is considered the ability to cope with adverse and negative events of life in a constructive way (Connor & Davidson, 2003), it can act as a protective factor for adolescents liver transplant recipient and liver transplant candidates in mitigating the onset of depression, anxiety and stress symptoms.

Resilience is multidimensional (Q. Zhang *et al*., 2020) determined by different factors, such as individual, psychological and biological traits, relationships with peers and family and it is influenced by the sociocultural context (Norris *et al*., 2002). Individuals with high resilience tend to have an optimistic view of events and to see negative experiences as a chance to grow and learn, focus on personal resources, develop and maintain significant relationship with other and are more conscious of their internal emotional processes (Babić *et al*., 2020). From a neurobiological point of view, resilience is connected to the reactions to acute or chronic stress, thus is implicated in the stress response system (Casale *et al*., 2019).

In our study, the theory of reference is based on *the Resiliency model* developed by Richardson *et al*. (1990). The premise of this model is that every individual seeks adaptation to a state of biopsychospiritual balance (*homeostasis*) (Cynthia Carbo & Nancy Goldstein, 2018; Q. Zhang *et al*., 2020). This homeostasis is often exposed to the risk of alteration by stressful events and adversity. New life events or adverse circumstances disrupt homeostasis that require energy for reintegration and growth. In order to restore the balance and become more resilient, individuals must reorganize their life, learn from previous experience and overcame past challenges (Richardson *et al*., 1990). Consequently, individual's ability to cope with adverse events and challenging circumstances is influenced by previous adaptation when facing disruption or restoring the balance (Q. Zhang *et al*., 2020).

Adolescence is commonly characterized by many disruptions. Lack of experience and less coping skills can make adolescence difficult and can compromise future outcomes. Recent studies have found a correlation between resilience and the prevention of psychopathologies, meaning that resilience helps reducing depression and anxiety (Barzilay *et al*., 2020b). Moreover, resilience can lead to better psychological and mental health condition (Q.

Zhang *et al*., 2020). Our results show that with the increase of CD-RISC total score, the score of DAAS-21 scales depression, anxiety and stress decreased significantly. The observation that as resilience increases, depression, anxiety and stress decrease, suggests that resilience represents a protective factor towards the onset and the evolution of depression, anxiety and stress levels. Specifically, our results showed that for each unit increase of CD-RISC total score, the score DAAS-21 depression decreases, on average, of 0.30 points (similarly, for each increase of 10 points on CD-RISC score, the Depression score decreases, on average, of 3 points). For each unit increase of CD-RISC total score, the score DAAS-21 anxiety decreases, on average, of 0.11 points. Moreover, for each unit increase of CD-RISC total score, the score DAAS-2 stress decreases, on average, of 0.16 points.

COVID-19 pandemic together with the necessary social spreading control measures, have caused enormous disruption in daily life of adolescents, posing a great challenge for their mental well-being (Shah *et al*., 2020). Although the consequences of COVID-19 are incomparable, exposure to others disaster events like hurricane, or earthquake, or terrorism attacks have the same potential to impact many persons at the same time, inducing the onset of various psychopathologies (Goldmann & Galea, 2014) and thus causing different stressors (Norris *et al*., 2002), at the same time, emotional resilience lies in the same adverse environments as disasters. The resilience does not mean the complete absence of any psychopathological symptoms following exposure to traumatic event; rather, it represents the capacity to *bounce back* (Goldmann & Galea, 2014) and it is commonly recognized as a useful response to disasters (Sandifer & Walker, 2018). Many empirical studies, before COVID-19 pandemic, showed that resilience is negatively correlated with depression and anxiety, and it is positively correlated with positive indicators of mental well-being (Hu *et al*., 2015). These results support our initial hypothesis, that considers high resilience a protective factor in preventing the onset of negative psychological symptoms in adolescents during various adverse events, not only in time of COVID-19 pandemic.

Our findings on a population of adolescent liver transplant recipients and liver transplant candidates (already managing a chronic condition) are consistent with the recent literature investigating the impact of COVID-19 on adolescent mental health and how resilience can be a protective factor towards the onset of negative psychological symptoms and psychopathologies such as depression, anxiety and stress, which are strictly dependent on the consequences of COVID-19 pandemic. Therefore, our results suggest that health professionals should strive on building up resilience in adolescents aiming to prevent depression, anxiety and stress.

There are limitations in our study. First of all, the study was conducted on a relatively small sample of patients (n=66 patients). Even though studies with a larger sample could provide more accurate results, we have to highlight that

only a few liver transplant centres in the world can actually provide a large enough *transitional population* to be studied. Secondly, although we have made a great effort in investigating the psychological distress in adolescent/young transitional adult liver candidates and recipients during the COVID-19 pandemic utilizing specific tools, we cannot assert with certainly that the pandemic was the only factor influencing patients responses on distress and resilience measure because the absence of scores on psychological measures before the lockdown. Nonetheless, our hypothesis is that pandemic containment measures such as lockdown and social limitations, have undoubtedly impacted patients mental health; and resilience, as the individual ability to constructively overcome adverse events, can definitely represent a protective factor for the onset of psychopathologies. Finally, a 5-points Likert scale was chosen to measure the perception and the concerns of the patients towards the pandemic at the time of the design of the study at the very start of pandemic in Italy (March, 2020), before the release of the COVID-related measures proposed by the World Health Organization, which become available in July 2020.

Contributions: A.M., D.R., MS.S., S.F. designed the study; A.M, D.R., S.F., L.DA., M.C., wrote the manuscript; A.M., collected data; A.M., D.R., A.G. analysed data; L.P., F.L., P.S., M.G., MG.L., E.B., M.C., L.DA. participated in the performance of the research.

Conflict of interest: the authors declare no potential conflict of interest.

Ethical approval: informed consent of patients was collected verbally. The institutional Review Board provided approval for the study (257/2020, 13/02/2020).

Availability of data and materials: the datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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