

## Optimism, Resilience, and Infertility-Specific Stress during Assisted Reproductive Technology

Diana Santa-Cruz<sup>a</sup>, Soledad Chamorro<sup>a</sup>, and Rafael A. Caparros-Gonzalez<sup>b,c</sup>

<sup>a</sup>IVI-RMA, Madrid, Spain; <sup>b</sup>University of Granada, Spain; <sup>c</sup>Instituto de Investigación Biosanitaria ibs.GRANADA, Granada, Spain

### ARTICLE INFO

#### Article history:

Received 18 November 2022

Accepted 22 May 2023

#### Keywords:

Assisted reproductive technology (ART)  
Infertility  
Optimism  
Resilience  
Stress  
Perinatal  
Infertility-specific stress

#### Palabras clave:

Técnicas de reproducción asistida (TRA)  
Infertilidad  
Optimismo  
Resiliencia  
Estrés  
Perinatal  
Estrés específico de la infertilidad

### ABSTRACT

**Background:** Infertility generates high levels of stress to women. The aim was to explore optimism and resilience among women undergoing assisted reproductive technology (ART). **Method:** Participants were recruited in a private fertility clinic. The sample consisted of 229 women under medical treatment for fertility who completed the following self-report instruments: a sociodemographic and clinical questionnaire, Resilience Scale (RS), Life Orientation Test (LOT-R), Perceived Stress Scale (PSS), and STAI State and STAI Trait. **Results:** Our data revealed that high resilience levels were associated with a reduced psychological stress ( $\beta = .02, p < .001, 95\% \text{ CI } [.34, .13]$ ). A significant negative correlation between perceived stress and resilience ( $r = -.320, p = .001$ ) was found. **Conclusion:** The findings highlight the protective mediating role of resilience when women are confronted with the negative effects of infertility diagnosis and assisted reproductive technology (ART), and therefore the potential utility of resilience to reduce infertility-specific stress.

### El optimismo, la resiliencia y el estrés específico por infertilidad en la aplicación de las técnicas de reproducción asistida

### RESUMEN

**Antecedentes:** La infertilidad genera un nivel de estrés elevado en la mujer. El objetivo era explorar el optimismo y la resiliencia en las mujeres que se someten a técnicas de reproducción asistida (TRA). **Método:** Los participantes fueron reclutados en una clínica de fertilidad privada. La muestra estuvo conformada por 229 mujeres en tratamiento médico para de fertilidad que cumplimentaron los siguientes instrumentos de autoinforme: cuestionario sociodemográfico y clínico, Escala de Resiliencia (RS), Test de Orientación a la Vida (LOT-R), Escala de Estrés Percibido (PSS) y STAI Estado y Rasgo. **Resultados:** Los datos revelaron que un nivel elevado de resiliencia se asociaba con menos estrés psicológico ( $\beta = .02, p < .001, \text{IC del } 95\% \text{ } [.34, .13]$ ). Se obtuvo una correlación negativa significativa entre estrés percibido y resiliencia ( $r = -.320, p = .001$ ). **Conclusión:** Los hallazgos resaltan el papel mediador protector de la resiliencia cuando las mujeres se enfrentan a los efectos negativos del diagnóstico de infertilidad y las técnicas de reproducción asistida (TRA) y, por lo tanto, la utilidad potencial de la resiliencia para reducir el estrés específico de la infertilidad.

The psychological impact of infertility has been described based on both clinical observation and empirical research. Infertility can lead individuals and couples to have very high levels of multifaceted stress (Boivin et al., 2011; Cousineau & Domar, 2007; Donarelli et al., 2016) and depression (Verhaak et al., 2007). A systematic review (Conversano et al., 2010) including 23 studies concluded that protective factors for psychological adjustment during in vitro treatments included trait optimism, problem-focused coping, positive family/marital function, social support, situation appraisal involving acceptance of the situation, and secure attachment style.

Originally proposed by Carver and Scheier (2014), dispositional optimism can be defined as the global expectation that things will turn out well in the future and bad things will be scarce. This is particularly relevant to clinical psychology due to its protective role to reduce the risk of developing a psychopathology (Kleiman et al., 2017). Similarly, it seems to confer high resilience during stressful life events, and this resilience is negatively associated with both the onset and the recurrence of psychological distress (Cousins et al., 2014; Kleiman et al., 2017). Resilience, conceptualized as the capacity and dynamic process of adaptively overcoming uncertainty, conflict, and

Cite this article as: Santa-Cruz, D., Chamorro, S., Caparros-Gonzalez, R. A. (2023). Optimism, resilience, and infertility-specific stress during assisted reproductive technology. *Clínica y Salud*, 34(2), 79-84. <https://doi.org/10.5093/clysa2023a19>

Correspondence: [rcg477@ugr.es](mailto:rcg477@ugr.es) (R. A. Caparros Gonzalez).

ISSN: 1130-5274/© 2023 Colegio Oficial de la Psicología de Madrid. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

adversity while maintaining normal psychological and physical functioning, is a necessary factor during stressful situations related to maternity (García-León et al., 2019).

More precisely, it can be defined as the belief that a person can control the way one copes with adversity. It is one of the strongest buffers against mental health problems (Mancini & Bonanno, 2009). Resilience may be critical in determining how individuals cope with and adapt to stress (Chrzan-Detkos et al., 2022; Johnson et al., 2017).

Psychological stress arises from connections between individuals and their environment that are felt that exceed their adaptive capacities and threaten their wellbeing (Caparros-Gonzalez et al., 2022; Cohen et al., 2007). In the context of infertility, women can experience high levels of stress (Rooney & Domar, 2018). Unsuccessful attempts during assisted reproductive technology (ART) can be associated with infertility-specific stress, which refers to a type of psychological stress related to the sense of loss, failure, and shame in women diagnosed with infertility (Patel et al., 2016). Infertility-specific stress can progress to depression and anxiety (Rockliff et al., 2014). Infertility-specific stress comprises different dimensions, namely, concerns related to the need of parenthood, concerns associated with rejections of a childless future (Bielawska-Batorowicz, 2022), perceived social concerns, and concerns regarding the impact of infertility on the couple relationship (Zurlo et al., 2020). All these dimensions fostered the development of further research aiming at identifying protective factors potentially reducing perceived distress among infertile couples (Donkor & Sandall, 2007). A previous study informed that resilience was a potential protective factor for a couple's quality of life and that could reduce infertility-specific stress among women undergoing ART (Herrmann et al., 2011).

As the prevalence of women undergoing infertility continues to increase worldwide, given the scientific plausibility that psychological stress can affect the success of fertility treatments and current recommendations regarding maternal mental health (Chrzan-Detkoś et al., 2022), there is a need to update and re-examine available research (Caparros-Gonzalez et al., 2019). In this context, it is necessary to explore the potential role of mediators that could buffer the consequences of high levels of stress and anxiety during ART procedures (Romano et al., 2012).

The aim of this study was to examine the mediating role of resilience and optimism on stress and anxiety in women undergoing assisted reproductive technologies (ART) in a private fertility clinic.

## Method

### Participants Using Assisted Reproductive Technology

The study was conducted in a sample of 229 women presenting an infertility diagnosis who were following medical treatment for infertility. Participants were recruited from the city of Madrid (Spain).

Eligibility criteria included: 1) women over 18 years old, 2) first visit to the fertility clinic, 3) currently trying to get pregnant with a male partner, and 4) proficiency in Spanish language. Women with a history of mental health disorder (psychopathological disorders such as depression and/or anxiety before diagnose) were excluded.

Aiming to obtain satisfactory results, a priori sample size requirements according to G\*Power Statistical software was established at a minimum sample size of 178 to acquire an adequate power of .80 and using an  $\alpha = .05$ . G\*Power statistical software is a powerful tool to calculate statistical power analyses, effect size, and sample size requirements for a variety of tests (Faul et al., 2009). A sample size requirement of  $n = 175$  was calculated to achieve a large effect size in the *a*-path and a medium effect in the *b*-path (Fritz & Mackinnon, 2007).

A total of 300 potential participants aimed to collaborate in this study. After excluding patients whose ART treatment was not com-

pleted ( $n = 23$ ), those having a spontaneous pregnancy before starting the treatment ( $n = 4$ ), and women reporting lack of time ( $n = 44$ ), the total sample size encompassed 229 women undergoing an ART treatment.

### Procedure to Study Infertility-Specific Stress

The Ethics Research Committee of the Institution (IVI-RMA) approved this study. This study followed the principles of the Declaration of Helsinki (AMM, 2008) and the Good Clinical Practice Directive (Directive 2005/28/EC) provided by the European Union. Participants were invited to participate prior their initial appointment with a reproductive endocrinologist at a university affiliated private infertility clinic between January and December 2018.

Participants were informed about the study aims. Participation was voluntary and anonymous. Those women willing to participate read and signed an informed consent form. Afterwards, participants were asked to fill up the psychological measures before their initial appointment with a reproductive endocrinologist at a university affiliated private infertility. Sociodemographic and medical data (including obstetrical variables) was also obtained (age, educational level, treatment, ART treatment, diagnosis of infertility, and number of previous children). Medical data were obtained from a participant's medical records.

The STROBE Statement for reporting cross-sectional studies was followed in the present study (Elm et al., 2007).

### Psychological Assessment of Perinatal Stress

The psychological self-report measures used in this study were applied to assess optimism, pessimism, resilience, perceived stress, state anxiety, and trait anxiety. In order to obtain this information, the following psychological self-report measures were applied:

**Resilience Scale** (RS; Wagnild & Young, 1993; Spanish version by Rodríguez et al., 2009)

This scale was used to assess the capacity to withstand life stressors, and to thrive and make meaning from challenges. This scale comprises a 17-items subscale named Personal Competence and a 8-items subscale named Acceptance of Self and Life. Resilience as described by Wagnild include 5 essential characteristics related with a meaningful life: purpose, perseverance, self-reliance, equanimity, and existential aloneness (i.e. coming home by yourself). Cronbach's alpha reliability coefficient of the Spanish version is  $\alpha = .79$ . Cronbach's alpha reliability coefficient of the current sample was  $\alpha = .81$ . According to the original version of this measure, a higher score suggests high levels of resilience (Wagnild & Young, 1993).

**Life Orientation Test Revised** (LOT-R; Scheier et al., 1994)

Dimensions of optimism and pessimism were evaluated using the 10-item Spanish version (Ferrando et al., 2002) This is a self-report questionnaire to assess an individual tendency to expect positive compared to negative outcomes. Items are scored on a 5-point Likert scale and summed to produce a total score. The measure also offers information on optimism and pessimism with two subscale scores. The LOT total score consists of 8 items and reflects a single bipolar dimension in which higher scores indicate greater optimism or less pessimism. Cronbach's alpha reliability coefficient of the Spanish version is  $\alpha = .72$ . Cronbach's alpha reliability coefficient of the current sample was  $\alpha = .73$ .

**Table 1.** Sociodemographic Data, Obstetric History, and Psychological Measures ( $N = 229$ )

Age	N (%)	Mean $\pm$ SD										
		STAI-S		STAI-T		LOT-R		RS		PSS		
20-29	12 (5)	22.83	$\pm$ 11.54	26.00	$\pm$ 8.25	14.58	$\pm$ 4.96	128.58	$\pm$ 20.36	23.15	$\pm$ 6.24	
30-39	149 (65)	23.38	$\pm$ 10.46	28.61	$\pm$ 8.38	16.12	$\pm$ 3.53	132.57	$\pm$ 15.72	22.52	$\pm$ 6.63	
$\geq 40$	68 (30)	24.19	$\pm$ 10.86	28.26	$\pm$ 7.79	17.62	$\pm$ 3.36	135.18	$\pm$ 15.96	23.7	$\pm$ 5.91	
Education												
University	105 (46)	23.43	$\pm$ 10.57	28.47	$\pm$ 8.00	16.21	$\pm$ 3.51	131.25	$\pm$ 15.37	24.56	$\pm$ 7.34	
High School	84 (37)	22.64	$\pm$ 10.57	27.60	$\pm$ 8.62	16.57	$\pm$ 3.97	134.43	$\pm$ 16.35	24.13	$\pm$ 6.12	
Middle School	40 (17)	26.00	$\pm$ 10.62	29.75	$\pm$ 7.76	17.03	$\pm$ 3.23	135.38	$\pm$ 17.05	25.12	$\pm$ 6.45	
Artificial reproductive technology												
1 - IVF/ICSI	78 (34)	23.15	$\pm$ 11.18	28.59	$\pm$ 8.45	15.83	$\pm$ 3.49	133.37	$\pm$ 16.52	24.23	$\pm$ 9.66	
2 - IVF/PGD	86 (38)	23.66	$\pm$ 10.96	23.66	$\pm$ 8.15	16.84	$\pm$ 3.65	131.87	$\pm$ 15.85	23.46	$\pm$ 8.13	
3 - OD	47 (20)	24.40	$\pm$ 9.66	24.40	$\pm$ 7.88	17.36	$\pm$ 3.19	134.96	$\pm$ 16.06	22.45	$\pm$ 7.13	
4 - IUI	18 (8)	23.00	$\pm$ 9.17	23.00	$\pm$ 8.10	15.33	$\pm$ 4.74	133.39	$\pm$ 15.86	24.35	$\pm$ 9.64	
Diagnosis related to infertility												
AMA	65 (28)	24.51	$\pm$ 10.22	28.12	$\pm$ 7.83	17.65	$\pm$ 3.14	134.22	$\pm$ 17.19	25.61	$\pm$ 6.34	
LOR	45 (20)	24.11	$\pm$ 11.37	28.87	$\pm$ 8.47	16.29	$\pm$ 3.77	132.18	$\pm$ 13.66	22.56	$\pm$ 6.47	
Endometriosis	26 (11)	22.46	$\pm$ 12.05	26.92	$\pm$ 7.33	16.58	$\pm$ 3.05	133.65	$\pm$ 16.56	28.97	$\pm$ 5.89	
Male Factor	36 (15)	22.44	$\pm$ 10.54	28.81	$\pm$ 9.38	15.67	$\pm$ 3.27	134.75	$\pm$ 16.90	21.95	$\pm$ 5.15	
Immunological	15 (7)	23.87	$\pm$ 9.66	28.87	$\pm$ 9.53	15.40	$\pm$ 3.85	136.47	$\pm$ 13.96	22.75	$\pm$ 6.12	
Recurrent Miscarriages	19 (9)	24.68	$\pm$ 11.68	30.95	$\pm$ 6.31	17.00	$\pm$ 4.20	128.32	$\pm$ 17.03	25.68	$\pm$ 6.31	
Idiopathic	23 (10)	21.96	$\pm$ 8.82	26.61	$\pm$ 8.33	15.04	$\pm$ 4.50	130.65	$\pm$ 16.40	27.78	$\pm$ 8.35	
Children												
0	196 (86)	23.57	$\pm$ 10.51	28.44	$\pm$ 8.22	16.52	$\pm$ 3.64	132.43	$\pm$ 16.18	28.67	$\pm$ 5.34	
1	33 (14)	23.73	$\pm$ 11.24	27.97	$\pm$ 8.15	16.30	$\pm$ 3.66	137.30	$\pm$ 14.91	22.15	$\pm$ 6.12	

Note. IVF/ICSI = in vitro fertilization with intracytoplasmic injection; IVF/PGD = in vitro fertilization with preimplantation genetic diagnosis; OD = oocyte donation; IUI = intra uterine insemination; AMA = advanced maternal age; LOR = low ovarian reserve

### STAI (Spielberger, 1983; Spanish version by Buela-Casal & Guillén-Riquelme, 2017)

This inventory was used to measure state and trait anxiety. The STAI consists of two subscales with 20 items each. The State Anxiety Scale (STAI-S) was used to assess the current state of anxiety and offers information on how respondents feel in that moment. Items reflect feelings of tension, worry, apprehension, nervousness, and activation/arousal of the autonomic nervous system. The Trait Anxiety Scale (STAI-T) was used to measure relatively steady aspects of anxiety proneness, including general states of calmness, confidence and security. All items were rated on a 4-point Likert scale (0 = *almost never* to 3 = *almost always*). Higher scores indicate greater anxiety. Cronbach's alpha reliability coefficient of the Spanish version is  $\alpha = .93$ . Cronbach's alpha reliability coefficient of the current sample was  $\alpha = .84$  for STAI-S and  $.82$  for STAI-T.

### Perceived Stress Scale (PSS)

This is a 14-item self-report questionnaire. This measure was used to assess the perception of general stress during the last month. The items are scored on a 5-point Likert scale (0 = *never* to 4 = *very often*). An overall score of 20 is considered moderately high. In this study we used the Spanish version (Cohen, 1983; Remor, 2006), which has a Cronbach's alpha reliability coefficient of  $\alpha = .82$ . Cronbach's alpha reliability coefficient of the current sample was  $\alpha = .75$ .

### Statistical Analysis

Statistical analysis was conducted using Social Package for Social Sciences SPSS Statistics Software (v.22; IBM SPSS Statistics). There were no missing data. Pearson's correlation coefficients were used to

study potential associations between study variables and age. Two mediation analyses were performed. The first tested whether the relationship between stress and symptoms of anxiety was mediated by resilience.

Structural equation modelling (SEM modelling) was used to test whether the relationship between stress and symptoms of anxiety was mediated by optimism. The mediating effect of resilience in the relationship between stress and symptoms of anxiety and stress while controlling for age was tested. SEM was used to fit a single model for each of the two relationships to estimate the indirect, direct, and total effects. A significant mediating effect was established when the 95% bias-corrected bootstrap confidence interval based on 1,000 bootstrap samples did not contain zero (McKinnon et al., 2004; Sobel, 1986).

In moderation analyses two series of nested models in multiple linear regression analyses were conducted in four steps. In step 1, age was entered. In step 2, three separate analyses were conducted in which stress and resilience were entered separately to ascertain their individual explained variance, and then altogether to test the compensatory model while the interaction (stress by resilience) term was entered in step 3 to test the protective model. Symptoms of anxiety was the outcome variable. Both stress and resilience variables (all continuous) were centered (Frazier et al., 2004) before they were entered in the analyses to test the interactional effect.

## Results

### Sample Characteristics

Women in this sample had an age ranging from 18 to 45 years ( $M = 36.83$  years,  $SD = 0.26$ ), with a history of infertility ranging from 6 to 60 months ( $M = 19.82$ ,  $SD = 0.89$ ). Participants in this sample had a range of diagnosis associated with infertility. In this respect, an amount of 65 women (28.38%) was diagnosed of

advanced maternal age (> 40 years old),  $n = 45$  women (19.21%) had a low ovarian reserve,  $n = 26$  (11.79%) endometriosis,  $n = 15$  (6.99%) suffered from an immunological disease (Hashimoto's disease, rheumatoid arthritis, antiphospholipid syndrome),  $n = 19$  (8.30%) had recurrent miscarriages,  $n = 36$  (15.72%) had a male factor, and  $n = 23$  (9.61%) were diagnosed from idiopathic infertility. Participants' clinical characteristics are presented in Table 1, including levels of resilience and optimism depending on the level of education.

**Test of the Mediation Model**

Correlation analysis between the psychological measures showed that state and trait anxiety were significantly associated with optimism ( $r = .037, p = .05$ , and  $r = .031, p = .05$ , respectively). Our results indicated a significant negative correlation between perceived stress and resilience ( $r = -.320, p = .001$ ). Perceived stress was significantly associated with state and trait anxiety ( $r = .560, p = .001$  and  $r = .220, p = .001$ ). Resilience was significantly and negatively correlated with state anxiety ( $r = -.210, p = .001$ ) and moderately (positive or negative) associated with trait anxiety ( $r = .160, p = .05$ ). Table 2 presents mean values, standard deviations and Pearson's correlations between age and the psychological measures (LOT-R, RS, STAI-S, STAI-T, PSS).

**Table 2.** Mean Values, Standard Deviations, and Pearson's Correlations between Age and Psychological Measures

	Mean	SD	1	2	3	4	5	6
1 Age	36.83	0.26	1					
2 Optimism	16.48	3.94	.195**	1				
3 Resilience	133.1	16.14	.022	.264**	1			
4 Anxiety State	23.59	10.59	.013	.037	-.210**	1		
5 Anxiety Trait	28.37	8.19	-.010	.031	.160*	.421**	1	
6 Perceived Stress	23.20	6.40	-.190**	.01	-.320**	.560**	.220**	1

\*  $p < .05$ , \*\*  $p < .001$ .

Two mediation analysis were performed using SEM modelling. Firstly, it was tested whether the relationship between stress and symptoms of anxiety was mediated by resilience. Secondly, it was tested whether the relationship between stress and symptoms of anxiety was mediated by optimism. The estimated of 95% bias-corrected bootstrap CI and results summary for the relationship between stress and symptoms of anxiety mediated by resilience are presented on Table 3 and Figure 1.

There was a significant indirect effect of stress on symptoms of anxiety through resilience ( $\beta = -6.29, p < .001, 95\% \text{ CI } [.16, .10]$ ). Resilience partially mediated the relationship between stress and anxiety symptoms ( $\beta = .02, p < .001, 95\% \text{ CI } [.34, .13]$ ) as: (i) the direct effect was smaller than the total effect of stress on symptoms of

anxiety and (ii) there was no zero in the 95% bias-corrected bootstrap confidence interval for the indirect effect.

No significant association was found between optimism and stress or anxiety.

**Table 3.** The Mediating Effects of Resilience in the Relationship between Stress and Symptoms of Anxiety ( $N = 229$ )

Effect	Symptoms of Anxiety		
	B (SE)	p-value	Bias corrected bootstrap 95% CI
a	.00 (.00)	< .001	
b	-6.29 (.95)	< .001	
c	.05 (.01)	< .001	
d	.02 (0.1)	.025	
a x b	.02 (.01)	< .001	.013, .34

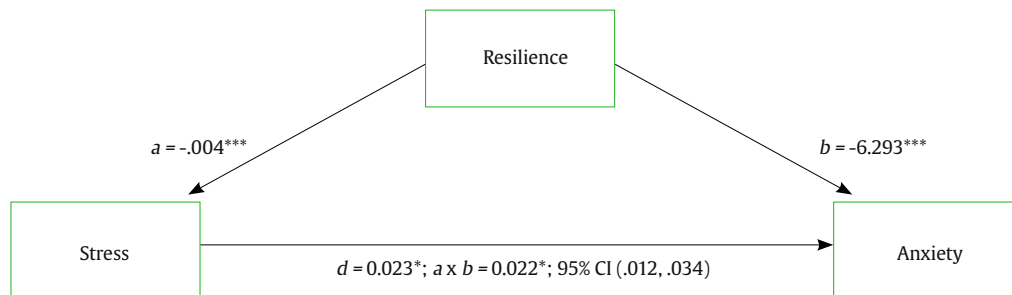
Note. B = Unstandardized path coefficient; SE = standard error; CI = confidence interval; a = effects of stress on resilience; b = effects of resilience on symptoms of anxiety after adjusting for stress; c = total effects of stress on symptoms of anxiety; d = direct effects of stress on symptoms of anxiety; a x b = mediating effects of resilience in the relationship between stress and symptoms of anxiety (i.e., the indirect effects of stress through resilience).

**Discussion**

The aim of this study was to examine the mediating role of resilience and optimism on stress and anxiety in women undergoing assisted reproductive technologies (ART).

Among different personal characteristics, resilience, defined as a measure of stress coping ability, could be a key factor handling adversity. In this context, exploring the constructs of resilience and optimism in women dealing with the multifaceted infertility-stress was considered the core aim of the current study.

Our findings showed that resilience partially mediated the relationship between stress and anxiety symptoms. Regarding the relationship between anxiety symptoms and stress the results supported a compensatory model of resilience. These findings indicate differences in the stability of resilience across stress and anxiety symptoms. Resilience has also been found to partially mediate stressful events and affective symptoms in previous studies (Charney, 2004; Hjemdal et al., 2006; Masten & Wright, 2009). High resilience levels among involuntary childless women suggests a high level of psychological stability. These results go in line with previous studies (Greil et al., 2010; Herrmann et al. 2011). In this respect, a recent review found that both optimism and resilience were negatively associated with stress and anxiety during ART procedures (Santa-Cruz et al., 2019). Findings from the present study suggest a tendency of women with infertility to adjust and to adapt in face of adversities (Coughlan et al., 2014). As expected, perceived stress was positively associated with symp-



**Figure 1.** Mediating effects of resilience in the relationship between stress and symptoms of anxiety ( $N = 229$ ).

Values are unstandardized path coefficients.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

toms of anxiety. This is consistent with previous studies of anxiety (Donarelli et al., 2016).

When resilience was considered as a mediator it was found that higher levels of perceived stress were associated with lower levels of resilience, which in turn was positively associated with anxiety symptoms. We can argue that infertility patients with higher levels of anxiety symptoms may at least have low access to navigate through and negotiate stress, to overcome adverse outcomes. This may suggest that increased resilience among infertile women could decrease the effect from stress, thereby reducing the impact on anxiety symptoms. A previous study reported additional reduction of maternal stress through support from health care providers (Kovacheva et al., 2022). Resilience accounted for more than double of the variance in anxiety symptoms compared to optimism which shows that resilience seems to be more important in explaining anxiety symptoms than optimism. It is important to acknowledge that resilience is a relatively general measure which is built from composite factors such as tenacity (persistence in maintaining value), strength (being strong with setback), and optimism (positive thinking) (Johnson et al., 2017). These factors may contribute differently in emotion regulation in infertility. Considering the three composite factors, we hypothesize that resilience regulates negative emotions and anxiety through optimism, which may explain why resilience appeared as a mediator of distress but no optimism. Previous studies have showed correlations between optimism and reduced anxiety levels (Bleil et al., 2012; Brissette et al., 2002; Lancaster & Boivin, 2005).

In the present study anxiety was found to be associated with stress. More precisely, it was found that perceived stress has a positive and moderate association with state anxiety, while the association between perceived stress and trait anxiety was also positive but weak. Our study disagrees with a previous study reporting a strong association between stress and anxiety among infertile women (Foti et al., 2023). Nevertheless, none of these studies used infertility-specific stress measures.

This study presents some limitations. Thus, this is a cross sectional study using psychological measures. Participants were recruited from a private fertility clinic by convenience sampling, which may limit the representation. Participants had a variety of diagnosis and medical treatments related to fertility. Additional longitudinal and experimental research is required to determine whether optimism and resilience can contribute to healthier behaviors and whether optimism and resilience could be an effective target to foster in order to reduce distress and maladaptive dysfunction during ART. The use of infertility-specific stress measures could offer alternative findings (Patel et al., 2016). Regarding the mediating effect of resilience, the change was small. However, data gave us the right to apply for partial mediation. More studies would be necessary to support (or not) these findings.

To our knowledge, this is the first study to analyze potential interactions between perceived stress, anxiety, and resilience among women using ART. This cross-sectional study has showed evidence for both direct effects and interactional effects to support both the compensatory and protective models of resilience respectively. Future studies are required, especially in similar samples, with research designs and statistical models that will account for the shared aspects of symptoms of anxiety, and also include depressive symptoms.

## Conclusions

This study contributed to a better understanding of the process linking resilience, optimism, anxiety, and psychological stress among women undergoing ART. High levels of resilience were found to be a potential protective factor for stress during ART processes. Resilience may be regarded as a latent and non-specific resource. Psychologists have a key role on promoting perinatal mental health among women

(Caparros-Gonzalez et al., 2021). Women undergoing ART are exposed to high levels of stress and anxiety (Bailey et al., 2017). Reasons for these high levels of stress are associated with the high number of medical procedures (i.e. ultrasound, gynecological check-ups, hormonal treatments), and sometimes the lack of success and continual disappointments (Toftager et al., 2018).

Clinical implications of this study include the positive potential role of resilience as a buffer of stress and anxiety among women undergoing ART. This study highlights the protective role of resilience when women and confronted by the adverse effects of stress and anxiety during ART procedures. Psychological interventions to improve resilience and optimism should be addressed on women who are about to go through ART. Therefore, the potential utility of resilience to enhance the psychological health of women should be maximized.

## Conflict of Interest

The authors of this article declare no conflict of interest.

## References

- Bailey, A., Ellis-Caird, H., & Croft, C. (2017). Living through unsuccessful conception attempts: A grounded theory of resilience among women undergoing fertility treatment. *Journal of Reproductive and Infant Psychology*, 35(4), 1-10. <https://doi.org/10.1080/02646838.2017.1320366>
- Bielawska-Batorowicz, E. (2022) How is a man supposed to be a man? Male childlessness – a life course disrupted, *Journal of Reproductive and Infant Psychology*, 40(4), 433-434. <https://doi.org/10.1080/02646838.2022.2061932>
- Bleil, M. E., Pasch, L. A., & Gregorich, S. E. (2012). Fertility treatment response: Is it better to be more optimistic or less pessimistic? *Psychosomatic Medicine*, 74(2), 193-199. <https://doi.org/10.1097/PSY.0b013e318242096b>
- Boivin, J., Griffiths, E., & Venetis, C. A. (2011). Emotional distress in infertile women and failure of assisted reproductive technologies: A meta-analysis of prospective psychosocial studies. *BMJ*, 342, Article d223. <https://doi.org/10.1136/bmj.d223>
- Brissette, I., Scheier, M. F., & Carver, C. S. (2022). The role of optimism in social network development coping, and psychological adjustment during a life transition. *Journal of Personalized Social Psychology*, 82(1), 102-111. <https://doi.org/10.1037/0022-3514.82.1.102>
- Buela-Casal, G., & Guillen-Riquelme, A. (2017). Short form of the Spanish adaptation of the State-Trait Anxiety Inventory. *International Journal of Clinical and Health Psychology*, 17(3), 261-268. <https://doi.org/10.1016/j.ijchp.2017.07.003>
- Caparros-Gonzalez, R. A., Lynn, F., Alderice, F., & Peralta-Ramirez, M. I. (2022). Cortisol levels versus self-report stress measures during pregnancy as predictors of adverse infant outcomes: A systematic review. *Stress*, 25(1), 189-212. <https://doi.org/10.1080/10253890.2022.2059348>
- Caparros-Gonzalez, R. A., Romero-Gonzalez, B., Puertas-Gonzalez, J. A., Quirós-Fernández, S., Coca-Guzmán, B., & Peralta-Ramirez, M. I. (2021). Midwives and psychologists as professionals to screen and prevent pregnancy-specific stress. *Revista Española de Salud Pública*, 95, Article e202104060.
- Caparros-Gonzalez, R. A., Romero-Gonzalez, B., Quesada-Soto, J. M., Gonzalez-Perez, R., Marinas-Lirola, J. C., & Peralta-Ramirez, M. I. (2019). Maternal hair cortisol levels affect neonatal development among women conceiving with assisted reproductive technology. *Journal of Reproductive and Infant Psychology*, 37(5), 480-498. <https://doi.org/10.1080/02646838.2019.1578949>
- Carver, C. S., & Scheier M. F. (2014). Dispositional optimism. *Trends in Cognitive Science*, 18(6), 293-299. <https://doi.org/10.1016/j.tics.2014.02.003>
- Charney, D. S. (2004). Psychobiological mechanisms of resilience and vulnerability: Implications for successful adaptation to extreme stress. *American Journal of Psychiatry*, 161(2), 195-216. <https://doi.org/10.1176/appi.ajp.161.2.195>
- Chrzan-Detkoś, M., Rodríguez-Muñoz, M. F., Krupelnyska, L., Morozova-Larina, O., Vavilova, A., López, H. G., Murawaska, N., & Radoš, S. N. (2022). Good practices in perinatal mental health for women during wars and migrations: A narrative synthesis from the COST Action Riseup-PPD in the context of the war in Ukraine. *Clinica y Salud*, 33(3), 127-135. <https://doi.org/10.5093/clysa2022a14>
- Cohen, S., Janicki-Deverts, D., & Miller, G. (2007). Psychological stress and disease. *JAMA*, 298, 1685-1687. <https://doi.org/10.1001/jama.298.14.1685>
- Cohen, S., Kamarack, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385-396. <https://doi.org/10.2307/2136404>

- Conversano, C., Rotondo, A., Lensi, E., Della Vista, O., Arpone, F. & Reda, M. A. (2010). Optimism and its impact on mental and physical well-being. *Clinical Practice & Epidemiology in Mental Health*, 6, 25-29. <https://doi.org/10.2174/1745017901006010025>
- Coughlan, C., Walters, S., Ledger, W., & Li, T. (2014). A comparison of psychological stress among women with and without reproductive failure. *International Journal of Gynaecology & Obstetrics*, 124(2), 143-147. <https://doi.org/10.1016/j.ijgo.2013.08.006>
- Cousineau, T. M., & Domar, A. D. (2007). The psychological impact of infertility. *Best Practice & Research Clinical Obstetrics & Gynaecology*, 21(2), 293-308. <https://doi.org/10.1016/j.bpobgyn.2006.12.003>
- Cousins, L. A., Cohen, L. L., & Venable, C. (2014). Risk and resilience in pediatric chronic pain: Exploring the protective role of optimism. *Journal of Pediatric Psychology*, 40(9), 934-942. <https://doi.org/10.1093/jpepsy/jsu094>
- Donarelli, Z., Lo-Coco, G., Gullo, S., Marino, A., Volpes, A., Salerno, L., & Allegra, A. (2016). Infertility-related stress, anxiety and ovarian stimulation: Can couples be reassured about the effects of psychological factors on biological responses to assisted reproductive technology? *Reproductive Biomedicine & Society Online*, 3, 16-23. <https://doi.org/10.1016/j.rbms.2016.10.001>
- Donkor, E., & Sandall, J. (2007). The impact of perceived stigma and mediating social factors on infertility-related stress among women seeking infertility treatment in Southern Ghana. *Social Science and Medicine*, 65(8), 1683-1694. <https://doi.org/10.1016/j.socscimed.2007.06.003>
- Elm, E. V., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting studies. *BMJ*, 335(7624), 806-808. <https://doi.org/10.1136/bmj.39335.541782.AD>
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G\* Power 3.1: Tests for correlation and regression analyses. *Behavioral Research Methods*, 41(4), 1149-1160. <https://doi.org/10.3758/BRM.41.4.1149>
- Ferrando, P. J., Chico, E., & Tous, J. M. (2002). Propiedades psicométricas del test de optimismo Life Orientation Test (LOT). *Psicothema*, 14(3), 673-680.
- Foti, F. L., Karner-Hutuleac, A., Maftai, A., & Maftai, A. (2023). The value of motherhood and psychological distress among infertile women: The mediating role of coping strategies. *Frontiers in Public Health*, 11, Article 87. <https://doi.org/10.3389/fpubh.2023.1024438>
- Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *Journal of Counseling Psychology*, 51(1), 115-134. <https://psycnet.apa.org/doi/10.1037/0022-0167.51.1.115>
- Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, 18(3), 233-239. <https://doi.org/10.1111/j.1467-9280.2007.01882.x>
- García-Leon, M. A., Caparros-Gonzalez, R. A., Romero-Gonzalez, B., Gonzalez-Perez, R., & Peralta-Ramirez, I. (2019). Resilience as a protective factor in pregnancy and puerperium: Its relationship with the psychological state, and with hair cortisol concentrations. *Midwifery*, 75, 138-145. <https://doi.org/10.1016/j.midw.2019.05.006>
- Greil, A., McQuillan, J., & Slauson-Blevins, K. (2010). *The social construction of infertility*. Wiley Online Library. <https://doi.org/10.1111/j.1751-9020.2011.00397.x>
- Herrmann, D., Scherg, H., Verres, R., Von Hages, C., Strowitzki, T., & Wischmann, T. (2011). Resilience in infertile couples acts as a protective factor against infertility-specific distress and impaired quality of life. *Journal of Assisted Reproduction and Genetics*, 28(11), 1111-1117. <https://doi.org/10.1007/s10815-011-9637-2>
- Hjemdal, O., Friborg, O., Stiles, T. C., Rosenvingem, J. H., & Martinussen, M. (2006). Resilience predicting psychiatric symptoms: A prospective study of protective factors and their role in adjustment to stressful life events. *Clinical Psychology & Psychotherapy*, 13(3), 194-201. <https://doi.org/10.1002/cpp.488>
- Johnson, J., Panagioti, M., Bass, J., Ramsey, L., & Harrison, R. (2017). Resilience to emotional distress in response to failure, error or mistakes: A systematic review. *Clinical Psychology Review*, 52, 19-42. <https://doi.org/10.1016/j.cpr.2016.11.007>
- Kleiman, E. M., Chiara, A. M., & Liu, R. T. (2017). Optimism and well-being: A prospective multi-method and multi-dimensional examination of optimism as a resilience factor following the occurrence of stressful life events. *Cognition and Emotion*, 31(2), 269-283. <https://doi.org/10.1080/02699931.2015.1108284>
- Kovacheva, K., Rodríguez-Muñoz, M. F., Baya, D. G., Salas, S. D., & Motrico, E. (2022). The relationship between healthcare experience and perinatal depression during COVID-19 pandemic. *Clinica y Salud*, 33(3), 117-125. <https://doi.org/10.5093/clysa2022a13>
- Lancastle, D., & Boivin, J. (2005). Dispositional optimism, trait anxiety, and coping: unique or shared effects on biological response to fertility treatment? *Health Psychology*, 24(2), 171-178. <https://psycnet.apa.org/doi/10.1037/0278-6133.24.2.171>
- MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research*, 39(1), 99-128. [https://doi.org/10.1207/s15327906mbr3901\\_4](https://doi.org/10.1207/s15327906mbr3901_4)
- Mancini, A. D., & Bonanno, G. A. (2009). Predictors and parameters of resilience to loss: Toward an individual differences model. *Journal of Personality*, 77(6), 1805-1832. <https://doi.org/10.1111/j.1467-6494.2009.00601.x>
- Masten, A. S., & Wright, M. O. (2010). Resilience over the lifespan: Developmental perspectives on resistance, recovery, and transformation. In J. W. Reich, A. J. Zautra, & J. S. Hall (Eds.), *Handbook of adult resilience* (pp. 213-237). The Guilford Press.
- Patel, A., Sharma, P. S., Narayan, P., Binu, V. S., Dinesh, N., & Pai, P. J. (2016). Prevalence and predictors of infertility-specific stress in women diagnosed with primary infertility: A clinic-based study. *Journal of Human Reproductive Sciences*, 9(1), 28-34. <https://doi.org/10.4103/0974-1208.178630>
- Remor, E. (2006). Psychometric properties of a European Spanish version of the Perceived Stress Scale (PSS). *The Spanish Journal of Psychology*, 9(1), 86-93. <https://doi.org/10.1017/S1138741600006004>
- Rockliff, H. E., Lightman, S. L., Rhidian, E., Buchanan, H., Gordon, U., & Vedarha, K. (2014). A systematic review of psychosocial factors associated with emotional adjustment in in vitro fertilization patients. *Human Reproduction Update*, 20(4), 594-613. <https://doi.org/10.1093/humupd/dmu010>
- Rodríguez, M., Pereyra, M. G., Gil, E., Jofré, M., De Bortoli, M., & Labiano, L. M. (2009). Propiedades psicométricas de la escala de resiliencia versión argentina. *Revista Evaluar*, 9(1), 72-82. <https://doi.org/10.35670/1667-4545.v9.n1.465>
- Romano, G., Ravid, H., Zaig, I., Schreiber, S., Azem, F., Shachar, I., & Bloch, M. (2012). The psychological profile and affective response of women diagnosed with unexplained infertility undergoing in vitro fertilization. *Archives of Women's Mental Health*, 15(6), 403-411. <https://doi.org/10.1007/s00737-012-0299-6>
- Rooney, K. L., & Domar, A. D. (2018). The relationship between stress and infertility. *Dialogues in Clinical Neuroscience*, 20(1), 41-47. <https://doi.org/10.31887/DCNS.2018.20.1/klrooney>
- Santa-Cruz, D., Chamorro, S., & García-Velasco, J. A. (2019). The mediating role of optimism and resilience on emotional distress in infertility: An integrative literature review. *International Journal of Psychological Research and Reviews*, 2, 22-22. <https://doi.org/10.28933/ijpr-2019-09-2105>
- Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A re-evaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, 67(6), 1063-1078. <https://doi.org/10.1037/0022-3514.67.6.1063>
- Sobel, M. E. (1986). Some new results on indirect effects and their standard errors in covariance structure models. In N. Tuma (Ed.), *Sociological Methodology* (pp. 159-186). American Psychological Association. <https://doi.org/10.2307/270922>
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Spielberger.
- Toftager, M., Sylvest, R., Schmidt, L., Bogstad, J., Løssl, K., Prætorius, L., Zedeler, A., Bryndorf, T., & Pinborg, A. (2018). Quality of life and psychosocial and physical well-being among 1,023 women during their first assisted reproductive technology treatment: Secondary outcome to a randomized controlled trial comparing gonadotropin-releasing hormone (GnRH) antagonist and GnRH agonist protocols. *Fertility and Sterility*, 109(1), 154-164. <https://doi.org/https://doi.org/10.1016/j.fertnstert.2017.09.020>
- Verhaak, C. M., Smeenk, J. M. J., Nahuis, M. J., Kremer, J. A. M., & Braat, D. D. M. (2007). Long-term psychological adjustment to IVF/ICSI treatment in women. *Human Reproduction*, 22(1), 305-308. <https://doi.org/10.1093/humrep/del355>
- Wagnild, G. M., & Young, H. M. (1993). Development and psychometric. *Journal of Nursing Measurement*, 1(2), 165-17847.
- Zurlo, M. C., Cattaneo, Della Volta, M. F., & Vallone, F. (2020). Re-examining the role of coping strategies in the associations between infertility-related stress dimensions and state-anxiety: Implications for clinical interventions with infertile couples. *Frontiers in Psychology*, 11, Article 614887. <https://doi.org/10.3389/fpsyg.2020.614887>