Factor structure and psychometric properties of the Fertility Problem Inventory–Short Form

Maria Clelia Zurlo, Maria Francesca Cattaneo Della Volta and Federica Vallone

Abstract
The study analyses factor structure and psychometric properties of the Italian version of the Fertility Problem Inventory–Short Form. A sample of 206 infertile couples completed the Italian version of Fertility Problem Inventory (46 items) with demographics, State Anxiety Scale of State-Trait Anxiety Inventory (Form Y), Edinburgh Depression Scale and Dyadic Adjustment Scale, used to assess convergent and discriminant validity. Confirmatory factor analysis was unsatisfactory (comparative fit index = 0.87; Tucker-Lewis Index = 0.83; root mean square error of approximation = 0.17), and Cronbach’s $\alpha$ (0.95) revealed a redundancy of items. Exploratory factor analysis was carried out deleting cross-loading items, and Mokken scale analysis was applied to verify the items homogeneity within the reduced subscales of the questionnaire. The Fertility Problem Inventory–Short Form consists of 27 items, tapping four meaningful and reliable factors. Convergent and discriminant validity were confirmed. Findings indicated that the Fertility Problem Inventory–Short Form is a valid and reliable measure to assess infertility-related stress dimensions.

Keywords
factor structure, Fertility Problem Inventory, infertility-related stress, reliability, validity

Introduction
Infertility is clinically described as a disease of the reproductive system defined by the failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse (Zegers-Hochschild et al., 2009) affecting 9%–15% of couples worldwide (Boivin et al., 2007) and 10%–12% of couples in Italy (ISTAT, 2015). Several studies highlighted that infertility is a deeply distressing experience affecting quality of life (Aarts et al., 2012; Huppelschoten et al., 2013; Monga et al., 2004; Onat and Beji, 2012; Ozkan et al., 2015; Shindel et al., 2008), self-esteem (Daniluk and Hurtig-Mitchell, 2003) and quality of marital and sexual relationships (Nelson et al., 2008; Repokari et al., 2007; Wischmann and Thorn, 2013; Yazdani et al., 2016), and inducing mood disorders, anxiety and depression (Luk and Loke, 2015; Peterson et al., 2013; Williams et al., 2007; Wischmann et al., 2001).

Referring to Lazarus and Folkman’s (1984) transactional model of stress process, in the last decades, several studies developed different measures to explore stress dimensions in infertile patients (Abbey et al., 1991; Bernstein et al., 1985; Collins et al., 1992; Glover et al., 1999). The Infertility Questionnaire (IFQ; Bernstein et al., 1985) consists of 21 items and was the first method developed to assess the psychological dysfunctions related to infertility with particular reference to three major areas, that is, self-esteem, blame and guilt, and quality of sexual life. Further tools examined specific life domains associated with the infertility experience. In particular, the Fertility Problem Stress Inventory (FPS; Abbey et al., 1991) consists of 14 items evaluating infertility-related stress covering the three dimensions of personal, social (i.e. family, friends and colleagues) and marital stress in infertile couples; the Infertility Reaction Scale (IRS; Collins. University of Naples Federico II, Italy

Corresponding author:
Maria Clelia Zurlo, Department of Political Sciences, University of Naples Federico II, Via L. Rodinò 22, 80138 Naples, Italy.
Email: zurlo@unina.it
et al., 1992) consists of 15 items and aimed at exploring the emotional reactions to infertility in terms of social pressure and sexual relationship. Finally, The Fertility Adjustment Scale (Glover et al., 1999) consists of 12 items aimed at assessing psychological reactions to fertility-related problems, mainly focusing on need for parenthood (e.g. importance to have a child) and the rejection/adjustment to a future life without a child, with only one item assessing the quality of couples’ relation in terms of communication.

All measures described has been considered adequate in terms of patients’ burden, due to the number of items included; nevertheless, each of them focused only on some specific dimensions of infertility-related stress.

In this perspective, the Fertility Problem Inventory (FPI; Newton et al., 1999) has been conceived as the first multidimensional questionnaire to assess all dimensions previously emphasized, that is, personal concern related to need for parenthood and rejection/adjustment to a future without a child; social concern related to perceived stress in relationships with family, friends and colleagues; and sexual and couple relationship concern.

The original version of the FPI was obtained by following a sequential strategy of scale construction and selecting all items able to enhance convergent and discriminative validity. The final 46-item questionnaire consisted of five scales identified as Sexual Concern (Sex; that is, diminished sexual enjoyment or sexual self-esteem, and sexual relations difficulties); Social Concern (Soc; that is, sensitivity to comments and reminders of infertility, feelings of social isolation and alienation from family or peers); Relationship Concern (Rel; that is, difficulty talking about infertility and concerns about the impact of infertility on the relationship); Need for Parenthood (Need; that is, perception of parenthood as primary or essential goal of life and close identification with role of parent); Rejection of Childfree Lifestyle (Rej; that is, perception of future satisfaction or happiness as dependent on having a child and negative view of childfree lifestyle). A composite measure of Global Stress was derived by summing the scores of all five scales. All five scales and the composite total scale revealed adequate levels of internal consistency, test–retest reliability, convergent validity (e.g. significant correlations with perceived anxiety, depression and dyadic adjustment) and discriminative validity (i.e. significant and low intercorrelations between the five scales). Finally, the authors of the test demonstrated that patterns of infertility-related stress assessed by the five scales of FPI differed depending on demographic and infertility-related characteristics.

The FPI identifies and measures significant domains of infertility-related stress. Research revealed that personal and marital stress dimensions significantly associated with treatment outcomes (Boivin and Schmidt, 2005; Cooper et al., 2007); moreover, it emerged significant gender differences concerning the effects of self-related stress dimensions on perceived levels of anxiety and depression (Lykeridou et al., 2009; Peterson et al., 2007), marital satisfaction (Peterson et al., 2003) and resilience processes (Herrmann et al., 2011; Sexton et al., 2010).

Validation studies of FPI have been proposed in different countries such as Greece (Gourounti et al., 2011), China (Peng et al., 2011), Portugal (Moura-Ramos et al., 2012) and Korea (Kim and Shin, 2014), substantially confirming the original structure of the questionnaire.

In Italy, the first validation study (Donarelli et al., 2015) didn’t confirm the original multidimensional structure of the test, and post hoc explorative factor analysis, conducted to determine the model of best fit, extracted two factors explaining 25% of variance. The first factor contained 29 items merging all the items from Relational Scale, Sexual Scale and most of the items from Social Scale of the original version, and it has been labelled Infertility Life Domain (α=0.85). The second extracted factor consisted of 14 items merging the original scale of Rejection of Childfree Lifestyle and Need for Parenthood, and it has been labelled Importance of Parenthood (α=0.80). Therefore, the original factor structure of the FPI has been only partially supported by this study, which reduced the dimensions explored by the test merging them into two factors.

In this perspective, this study moved both from the interest in the multidimensional structure of the FPI and from the consideration of the great burden of the 46-item original questionnaire. Therefore, it aimed to re-examine psychometric properties and factorial structure of the Italian version of the test in order to develop a valid and reliable Fertility Problem Inventory–Short Form (FPI-SF).

**Methods**

**Study design and participants**

The study protocol was approved by the Ethical Committee of the University were this study took place, and research was performed in accordance with the Declaration of Helsinki.

A cross-sectional study was conducted with the aim to re-examine psychometric properties and factor structure of the Italian version of FPI and to validate a short-form, comparing infertility-related stress dimensions emerged with respect to both individual characteristics of patients (gender, age and educational level) and infertility-related characteristics (type of diagnosis, presence of previous treatments and infertility treatment period).

The study was conducted between April 2015 and September 2016. Chairman of different Italian Centres of Assisted Reproduction of Naples (six centres), Udine (one centre) and Brescia (two centres) were contacted to enlist their participation to the project and gave the authorization for submitting a questionnaire to the infertile couples undergoing treatments in their centres. Inclusion criteria were as follows: (a) couples who had been diagnosed with infertility (Male Factor; Female Factor; Combined Male and Female Factor;
and Unexplained); (b) couples who were undergoing an infertility treatment of intrauterine insemination (IUI) or in vitro fertilization (IVF) or intracytoplasmic sperm injection (ICSI); c) the agreement by both members of the couple to participate in the study in order to consider couple sharing infertility problems as research unit. About 500 subjects (both partners of 250 couples) were asked by their physician to participate in the study before their appointment. If one or both partners refused to complete the survey, they were not included in the final data set; therefore, 12 couples with males not responding and 32 couples with no response from either partners were excluded. Overall, 206 couples (206 male, 206 female) completed the questionnaire (response rate = 82.4%).

The questionnaire lasting 20–25 minutes (one session) was submitted individually to both members of the infertile couples in a quiet room setting in the medical centre, and one of the authors was always present to answer any queries raised by participants. The respondents were informed of the objectives of the study, and informed consent was obtained from all participants. The couples voluntarily and anonymously participated in the survey, and received no compensation for their collaboration.

**Measures**

A questionnaire composed of five sections was submitted. Section 1 included items pertaining to socio-demographics (age, sex, educational level) and data on type of diagnosis (Male Factor; Female Factor; Combined Male and Female Factor; and Unexplained), presence of previous treatments (No/Yes) and infertility treatment period (≤ 1 year/>1 year). Data provided by the participants were double checked with those reported by the physicians. Section 2 consisted of the Italian version of the FPI (Donarelli et al., 2015), a self-administrated measure composed of 46 items on a 6-point Likert scale ranging from one (Strongly disagree) to six (Strongly agree), which provides a Global Stress score of perceived infertility-related stress ranging from 46 to 276. Section 3 consisted of the Scale of the State-Trait Anxiety Inventory (State-Trait Anxiety Inventory (Form Y) (STAI-Y); Spielberger, 1972), used to assess perceived levels of State Anxiety related to infertility in accordance with the literature (Csemiczky et al., 2000; Donarelli et al., 2015; Newton et al., 1999). The scale consists of 20 items rated on a 4-point scale ranging from one (Not at all) to four (Very much); total score ranges from 40 to 160. The DAS has been adapted to Italian (Gentili et al., 1999) and has been found to have satisfactory psychometric properties (Cronbach’s \( \alpha = 0.93 \)) and construct validity; the cut-off point for the Italian version was 9. Section 5 included the Dyadic Adjustment Scale (DAS; Spanier, 1976) which consists of 32 items rated on a 6-point scale ranging from zero (Always disagree) to five (Always agree); total score ranges from 0 to 160. The DAS has been adapted to Italian (Gentili et al., 2002) and has been found to have satisfactory psychometric properties (Cronbach’s \( \alpha = 0.93 \)) and construct validity; the cut-off point for the Italian version was 115.7.

**Statistical analysis**

Descriptive statistics, factor analysis, Pearson’s correlations and analyses of variance (ANOVA) were tested using SPSS version 21. Confirmatory factor analysis (CFA) was carried out using AMOS version 21. We considered different parameters of model fit: \( \chi^2 \) non-significant \( (p > 0.05) \), Tucker-Lewis Index (TLI > 0.95), root mean square error of approximation (RMSEA < 0.08) and comparative fit index (CFI > 0.95) (Hu and Bentler, 1998).

On the basis of data emerged, an exploratory factor analysis (EFA) using principal axis factoring analysis with oblique promax rotation was performed to improve the fit of the model with our data. The choice of non-orthogonal rotation was justified on the hypothesis that the factors would be correlated. The factorability of the correlation matrix of the FPI was evaluated by Kaiser–Meyer–Olkin (KMO) measure and Barlett test of sphericity. Criteria for extraction and interpretation of factors were as follows: eigenvalues > 1.0, Cattell’s scree test and inspection of scree plot, communality ≥ 0.30 for each item and factor loading > 0.32 for each item loading on each factor (Costello and Osborne, 2005). CFA was performed to assess the robustness of the structure of the FPI-SF derived from the EFA. Moreover, Mokken scale analysis was carried out using the R package ‘Mokken’ to further validate the emerged version of FPI-SF verifying the items homogeneity within the reduced subscales of the questionnaire. The scale’s and items’ Loevinger’s scalability coefficients \( H_i \) and \( H_j \), respectively were considered adequate if \( H_i > 0.30 \) (high degree of homogeneity of the set of items) and \( H_j > 0.30 \) for all items (item consistent with the set of items) (Sijtsma and Van der Ark, 2017; Stoechl et al., 2012).

Finally, Convergent validity was assessed by analysing the correlations of FPI-SF subscales and Global Stress scores with the standardized scales scores of STAI-Y, EDS, and DAS. Discriminant validity was evaluated by exploring the intercorrelations between the subscales, and ANOVA tests were used to analyse differences in FPI-SF subscales and Global Stress mean scores between subgroups of infertile patients divided by sex, age (the mean age of 34 years was used as a cut-off point), educational level (Junior Middle School; Senior School; College), type
Results

Characteristics of participants

The study was carried out in a sample of 206 Italian infertility couples. The ages of participants ranged from 22 to 48 years (Mean = 34.40, standard deviation (SD) = 3.85). All the 206 couples recruited had a diagnosis of primary infertility and 119 (57.7%) of them have undergone previous treatments. All demographic and infertility-related characteristics are provided in Table 1.

Item analysis of the original version of FPI

Preliminarily, the symmetrical distribution of item scores (skewness and kurtosis values) and the internal consistency (Cronbach’s α) were evaluated. The analysis produced values of skewness, and kurtosis for all items between −1.5 and 1.5, showing a normal distribution of scores.

The FPI revealed a very high Cronbach’s α (0.95), suggesting a redundancy of the items of the full questionnaire (Briggs and Cheek, 1986); indeed, a maximum α value of 0.90 is recommended (Tavakol and Dennick, 2011). Therefore, concerning the five subscales, two subscales had good internal consistency: that is, Rejection of Childfree Lifestyle (α=0.87) and Need for Parenthood (α=0.89), and three had poor internal consistency: that is, Social Concern (α=0.50), Sexual Concern (α=0.47) and Relationship Concern (α=0.43).

CFA

The theoretical model of the FPI (Newton et al., 1999) was tested by CFA, which indicated a low fit between data collected and the theoretical model: χ² value statistical significant (p<0.05), CFI=0.87, TLI=0.83, RMSEA=0.17. These results of CFA, the redundancy of items revealed by the high Cronbach’s α of the questionnaire and the low Cronbach’s α of three subscales of FPI suggested to carry out some modifications of the model in an attempt to improve it. In these cases, the procedure recommended is exploratory rather than confirmatory analysis (Browne, 2001). Consequently, an EFA was conducted to assess the structure of FPI and to improve its validity, internal consistency and discriminative capacity by removing redundant items.

EFA

The EFA was conducted using principal axis factoring analysis with oblique promax rotation. The assessment of factorability showed that the Kaiser–Meyer–Olkin measure was 0.83 and Barlett’s test of sphericity was significant (p<0.001) indicating that the data were adequate for the factor analysis. The examination of the scree plot produced a departure from linearity corresponding to a four-factor result; the scree test also confirmed that our data should be analysed for four factors. The first four eigenvalues were 7.74, 4.04, 2.81 and 1.34. The scree test supported that our data should be examined for four factors. With a KMO of 0.85, the overall fit of the model was found to be adequate (χ² =4.406.144, df=351, p<0.001). The first factor (10 items, explained variance=21.76%, Cronbach’s α=0.88) was loaded by items referred to sensitivity to comments and reminders.

Table 1. Demographic and infertility-related characteristics of participants (N=206 couples).

| Characteristics                                      | Value          |
|------------------------------------------------------|----------------|
| Age in years (mean±SD (range))                       |                |
| Male                                                 | 35.33±3.81 (24–48) |
| Female                                               | 33.47±3.67 (22–42) |
| Male educational level (n (%))                       |                |
| Junior Middle School                                 | 34 (16.5)      |
| Senior School                                        | 106 (51.5)     |
| College                                              | 66 (32.0)      |
| Female educational level (n (%))                     |                |
| Junior Middle School                                 | 44 (21.4)      |
| Senior School                                        | 86 (41.7)      |
| College                                              | 76 (36.9)      |
| Type of diagnosis (n (%))                            |                |
| Male Factor                                          | 58 (28.2)      |
| Female Factor                                        | 66 (32.0)      |
| Combined Male and Female Factor                      | 51 (24.8)      |
| Unexplained                                          | 31 (15.0)      |
| Type of treatment (n (%))                            |                |
| IVF                                                   | 120 (58.3)     |
| ICSI                                                  | 60 (29.1)      |
| IUI                                                   | 26 (12.6)      |
| Previous treatments (n (%))                          |                |
| No                                                    | 87 (42.3)      |
| Yes                                                   | 119 (57.7)     |
| Infertility treatment period (n (%))                 |                |
| ≤ 1 year                                              | 43 (20.8)      |
| > 1 year                                              | 163 (79.2)     |

IVF: in vitro fertilization; ICSI: intracytoplasmic sperm injection; IUI: intrauterine insemination.

of diagnosis (Male Factor; Female Factor; Combined Factor; Unexplained Factor), previous treatments (No/Yes) and infertility treatment period (1 year has been considered as a cut-off point in accordance with the literature; Kim and Shin, 2014).
concerning infertility and feelings of social isolation. This factor corresponded to the scale of Social Concern of the original version. The second factor (six items, explained variance = 11.75%, Cronbach’s α = 0.78) was loaded by items referred to the perception of parenthood as an essential goal in life. We labelled this scale Need for Parenthood as in the original version of the test. The third factor (six items, explained variance = 7.03%, Cronbach’s α = 0.77) was loaded by items concerning negative view of childfree lifestyle and perception of future happiness as dependent on having a child. This factor corresponded to the scale of Rejection of Childfree Lifestyle of the original version. The fourth factor (five items, explained variance = 3.45%, Cronbach’s α = 0.70) was loaded by items referred to difficulties in talking about infertility, concerns about the impact on couple relationship and sexual relations difficulties. This factor grouped the two scales (Relationship Concern and Sexual Concern) of the original version of FPI (Newton et al., 1999); consequently, we labelled it Couple’s Relationship Concern (Table 2). The Confirmatory Factors Analysis revealed satisfactory fit of the data structure emerged with the model (χ² is not significant p > 0.05; CFI = 0.97; TLI = 0.96; RMSEA = 0.05). Moreover, the Mokken scale analysis revealed adequate scalability for all items and subscales of the test, highlighting that the scale level Looevinger’s coefficients were higher than 0.30 for all the four subscales (Social Concern H = 0.46, Need for Parenthood H = 0.39, Rejection of Childfree Lifestyle H = 0.38, Couple’s Relationship Concern H = 0.39) and that item level Looevinger’s coefficients were higher than 0.30 for all the 27 items.

Table 3 illustrates items, means, SD and ranges of the FPI Short-Form subscales and the total scale (Global Stress), useful to achieve normative scores. Considering that high levels of infertility-related stress can be indicated by scores that are 1 SD above the mean (e.g. the 84th percentile) and low levels of stress can be indicated by scores that are 1 SD below the mean (e.g. the 16th percentile) of the normal distribution of the FPI-SF scores, we can affirm that scores of 72 or below indicate low infertility-related stress, scores of 73–111 indicate average infertility-related stress and scores of 112 or more indicate high infertility-related stress.

**Item analysis of the FPI-SF**

Following the analysis of the factor structure of the FPI, the emerged new short version of the questionnaire has been submitted to item analysis. Mean scores for the single items varied from a maximum score of 4.78 (Item 5: ‘Being a parent is a more important goal than having a satisfying career’) to a minimum of 1.81 (Item 22: ‘Having sex is difficult because I don’t want another disappointment’). SDs for the single items varied from 2.02 (Item 44: ‘It doesn’t bother me when others talk about their children’) to 1.26 (Item 22: ‘Having sex is difficult because I don’t want another disappointment’). The skewness and kurtosis varied from −1.5 to 1.5, indicating a normal distribution of the scores. Item total correlation was significant for all items (0.20 < r < 0.74; p ≤ 0.001), and the mean inter-item correlation 0.18 was satisfactory (Clark and Watson, 1995). Cronbach’s α of the total scale was 0.85. The overall findings of item analysis accounted for adequate reliability of the Italian FPI-SF.

**Convergent and discriminant validity**

Correlations with measures of State Anxiety (STAI-Y), Depression (EDS) and Dyadic Adjustment (DAS Tot) were carried out to test convergent validity, showing that all FPI-SF subscales and Global Stress scores were significantly related in the expected directions (Table 4).

Concerning discriminant validity, intercorrelations between the scales of FPI-SF and correlations between the four subscales and the Global Stress scores were calculated (Table 5). Intercorrelations ranged from 0.04 to 0.46, showing low to moderate levels (Cohen, 1988) and correlations of all FPI-SF subscales with Global Stress scores were high in size and significant, indicating that the questionnaire assessed different but related dimensions.

Moreover, ANOVA tests (Table 6) showed, concerning demographic characteristics, that female infertile patients perceived significantly higher levels of Need for Parenthood and Global Stress; both male and female infertile patients >34 years reported higher levels of Need for Parenthood and Global Stress, and both male and female infertile patients with higher educational levels revealed higher levels of Social Concern and lower levels of Need for Parenthood and Rejection of Childfree Lifestyle. Moreover, concerning infertility-related characteristics, Male Factor was associated with higher levels of Social Concern, Need for Parenthood, Couple’s Relationship Concern and Global Stress in male patients; Female Factor was associated with higher levels of Need for Parenthood, Rejection of Childfree Lifestyle, Couple’s Relationship Concern and Global Stress in female patients; and Combined Factor was associated with higher levels of all subscales and Global Stress in both male and female patients. Finally, infertility treatment period >1 year was associated with higher levels of Social Concern, in male patients, with higher levels of Couple’s Relationship Concern, in female patients and with higher levels of Need for Parenthood, Rejection of Childfree Lifestyle and Global Stress both in male and female patients.

**Discussion**

Findings highlighted that the proposed Italian FPI-SF possessed adequate factor validity and reliability, tapping four meaningful and reliable factors which allowed to
Table 2. Factor structure of the 27-item Fertility Problem Inventory–Short Form (FPI-SF).

| Factor and items                                                                 | 1     | 2     | 3     | 4     | \(h^2\) |
|---------------------------------------------------------------------------------|-------|-------|-------|-------|--------|
| **Social Concern** (Cronbach’s \(\alpha = 0.88\))                              |       |       |       |       |        |
| 40. When I see families with children I feel left out                            | 0.98  | 0.06  | −0.04 | −0.22 | 0.73   |
| (Quando vedo famiglie con bambini mi sento escluso)                              |       |       |       |       |        |
| 39. I find it hard to spend time with friends who have young children           | 0.84  | 0.01  | −0.07 | −0.09 | 0.64   |
| (Trovo difficile trascorrere del tempo con amici che hanno figli piccoli)       |       |       |       |       |        |
| 35. I still have lots in common with friends who have children                  | 0.69  | −0.24 | 0.22  | 0.03  | 0.49   |
| (Ho ancora molte cose in comune con gli amici che hanno figli)                  |       |       |       |       |        |
| 43. I feel like friends or family are leaving us behind                          | 0.66  | 0.20  | 0.08  | 0.09  | 0.54   |
| (Ho la sensazione che amici e familiari si stiano allontanando da noi)          |       |       |       |       |        |
| 30. I can’t help comparing myself with friends who have children                | 0.66  | 0.33  | −0.06 | −0.05 | 0.61   |
| (Non riesco a evitare di paragonarmi ad amici che hanno figli)                  |       |       |       |       |        |
| 27. Family get-togethers are especially difficult for me                         | 0.63  | 0.03  | −0.09 | −0.03 | 0.42   |
| (Le riunioni familiari sono particolarmente difficili per me)                   |       |       |       |       |        |
| 44. It doesn’t bother me when others talk about their children                  | 0.56  | −0.21 | 0.12  | −0.02 | 0.35   |
| (Non provo disagio quando gli altri parlano dei loro figli)                    |       |       |       |       |        |
| 19. I feel empty because of our fertility problem                               | 0.55  | 0.28  | 0.03  | 0.07  | 0.53   |
| (Mi sento vuoto/a a causa del nostro problema di fertilità)                     |       |       |       |       |        |
| 45. Because of infertility, I worry that my partner and I are drifting apart    | 0.51  | −0.06 | −0.02 | 0.20  | 0.42   |
| (Temo che il mio partner ed io ci allontaneremo poco a poco a causa dell’infertilità) |       |       |       |       |        |
| 13. I feel like I have failed at sex                                            | 0.43  | 0.04  | −0.08 | 0.24  | 0.40   |
| (Sento di aver fallito a livello sessuale)                                      |       |       |       |       |        |
| **Need for Parenthood** (Cronbach’s \(\alpha = 0.78\))                        |       |       |       |       |        |
| 34. As long as I can remember. I’ve wanted to be a parent                       | 0.01  | 0.74  | −0.04 | −0.04 | 0.51   |
| (Da che mi ricordo ho sempre desiderato diventare genitore)                     |       |       |       |       |        |
| 29. I have often felt that I was born to be a parent                             | 0.01  | 0.70  | −0.10 | 0.03  | 0.51   |
| (Ho spesso pensato che ero nato per diventare genitore)                         |       |       |       |       |        |
| 5. For me, being a parent is a more important goal then having a satisfying career | −0.14 | 0.65  | 0.10  | 0.03  | 0.44   |
| (Per me diventare genitore è un obiettivo più importante dell’avere una carriera lavorativa soddisfacente) |       |       |       |       |        |
| 42. I will do just about anything to have a child/another child                 | −0.10 | 0.62  | −0.02 | −0.11 | 0.34   |
| (Farò qualsiasi cosa per avere un figlio/altro figlio)                          |       |       |       |       |        |
| 6. My marriage needs a child/another child                                      | −0.01 | 0.53  | 0.09  | 0.07  | 0.36   |
| (Il mio matrimonio ha bisogno di un figlio/altro figlio)                        |       |       |       |       |        |
| 10. A future without a child/another child would frighten me                   | 0.20  | 0.38  | 0.16  | 0.13  | 0.43   |
| (Un futuro senza un figlio/altro figlio mi spaventerrebbe)                      |       |       |       |       |        |
| **Rejection of Childfree Lifestyle** (Cronbach’s \(\alpha = 0.77\))            |       |       |       |       |        |
| 28. Not having a child/another child would allow me time to do other satisfying things | −0.11 | 0.07  | 0.76  | −0.06 | 0.55   |
| (Non avere un figlio/un altro figlio mi consentirebbe di avere il tempo per fare altre cose soddisfacenti) |       |       |       |       |        |
| 15. I could see a number of advantages if we didn’t have a child                | 0.05  | 0.03  | 0.63  | −0.20 | 0.43   |
| (Potrei individuare un certo numero di vantaggi nel non avere un figlio/altro figlio) |       |       |       |       |        |
| 25. At times, I seriously wonder if I want a child/another child                | 0.04  | 0.03  | 0.60  | −0.26 | 0.43   |
| (Talvolta mi domando se voglio veramente avere un figlio/altro figlio)          |       |       |       |       |        |
| 31. Having a child/another child is not necessary for my happiness             | 0.18  | −0.03 | 0.60  | 0.18  | 0.44   |
| (Avere un figlio/altro figlio non è necessario per la mia felicità)            |       |       |       |       |        |
| 41. There is a certain freedom without children that appeals to me              | −0.13 | −0.03 | 0.59  | 0.10  | 0.34   |
| (C’è una certa libertà nel non avere bambini che mi attira)                     |       |       |       |       |        |
| 23. Having a child/another child is not the major focus of my life             | 0.17  | 0.01  | 0.48  | 0.19  | 0.37   |
| (Avere un figlio/altro figlio non è l’obiettivo principale della mia vita)   |       |       |       |       |        |
| **Couple’s Relationship Concern** (Cronbach’s \(\alpha = 0.70\))              |       |       |       |       |        |
| 16. My partner doesn’t understand the way the fertility problem affects me    | 0.04  | −0.06 | −0.07 | 0.65  | 0.35   |
| (Il mio partner non riesce a capire quanto il problema della fertilità influenza su di me) |       |       |       |       |        |
| 21. It bothers me that my partner reacts differently to the problem            | −0.14 | 0.04  | −0.04 | 0.62  | 0.32   |
| (Il fatto che il mio partner reagisca in maniera diversa da me al problema dell’infertilità mi disturba) |       |       |       |       |        |

(Continued)
Table 3. Items, mean, SD and range scores of Fertility Problem Inventory–Short Form scales.

| FPI-SF scales                      | Items                        | Mean ± SD          | Range |
|------------------------------------|------------------------------|--------------------|-------|
| Social Concern                     | 40, 39, 35, 43, 30, 27, 44, 19, 45, 13 | 26.43 ± 11.76      | 10–55 |
| Need for Parenthood                | 34, 29, 5, 42, 6, 10          | 26.54 ± 6.31       | 6–36  |
| Rejection of Childfree lifestyle   | 28, 15, 25, 31, 41, 23        | 26.73 ± 6.57       | 6–36  |
| Couple’s Relationship Concern      | 16, 21, 36, 22, 17            | 11.62 ± 4.90       | 5–27  |
| Global Stress                      | all items                    | 91.33 ± 19.68      | 45–149|

FPI-SF: Fertility Problem Inventory–Short Form.

Table 4. Correlations of Fertility Problem Inventory–Short Form scales with State Anxiety, Depression and Dyadic Adjustment scales.

|                     | Social Concern | Need for Parenthood | Rejection of Childfree Lifestyle | Couple’s Relationship Concern | Global Stress |
|---------------------|----------------|---------------------|----------------------------------|-----------------------------|---------------|
| State Anxiety       | 0.49**         | 0.15***             | 0.16**                           | 0.37***                     | 0.41**        |
| Depression          | 0.16**         | 0.20***             | 0.36**                           | 0.37***                     | 0.26**        |
| Dyadic Adjustment   | –0.55**        | –0.29***            | –0.11*                           | –0.34**                     | –0.35**       |
| Scale (Total score) |                |                     |                                  |                             |               |

*p < 0.05; **p < 0.01.

Table 5. Intercorrelations between Fertility Problem Inventory–Short form (FPI-SF) scales.

| FPI-SF scales                  | Social Concern | Need for Parenthood | Rejection of Childfree Lifestyle | Couple’s Relationship Concern | Global Stress |
|-------------------------------|----------------|---------------------|----------------------------------|-----------------------------|---------------|
| Social Concern                |               |                     |                                  |                             |               |
| Need for Parenthood           | 0.19**        |                     |                                  |                             |               |
| Rejection of Childfree lifestyle | 0.09          | 0.29***             |                                  |                             | 0.04          |
| Couple’s Relationship Concern | 0.46**        | 0.33***             | 0.04                             | 1                           |               |
| Global Stress                 | 0.80**        | 0.61***             | 0.49**                           | 0.64**                      | 1             |

*p < 0.05; **p < 0.01.

substantially confirm the original multidimensional structure of the FPI (Gourounti et al., 2011; Kim and Shin, 2014; Moura-Ramos et al., 2012; Newton et al., 1999; Peng et al., 2011). Three dimensions of the original version, that is, Social Concern, Need for Parenthood and Rejection of Childfree Lifestyle, were confirmed in the FPI-SF, and two dimensions, that is, Relationship Concern and Sexual Concern scales, merged in one factor, consequently labelled Couple’s Relationship Concern, overall highlighting a structure of FPI-SF which agrees with the four-factor structure emerged from the Greek validation study of the FPI (Gourounti et al., 2011).
Table 6. Differences in the Fertility Problem Inventory–Short Form scales scores by gender, age, educational level, type of diagnosis, presence of previous treatments, infertility treatment period.

|                          | Social Concern | Need for Parenthood | Rejection of Childfree Lifestyle | Couple’s Relationship Concern | Global Stress |
|--------------------------|---------------|---------------------|---------------------------------|-------------------------------|---------------|
| **Gender**               |               |                     |                                 |                               |               |
| Male                     | 25.85 ± 11.86 | 26.68 ± 6.43        | 26.12 ± 6.39                    | 11.03 ± 4.61                  | 88.73 ± 19.01 |
| Female                   | 27.50 ± 11.58 | 28.44 ± 6.09        | 27.07 ± 6.76                    | 12.24 ± 5.11                  | 93.93 ± 20.03 |
| **F**                    | 2.21          | 7.75*               | 0.016                           | 2.75                          | 7.30*         |
| **Age**                  |               |                     |                                 |                               |               |
| ≤ 34 years               | 25.22 ± 11.03 | 26.09 ± 10.43       | 25.64 ± 10.32                   | 12.61 ± 5.87                  | 87.67 ± 18.21 |
| > 34 years               | 26.87 ± 11.76 | 28.13 ± 11.39       | 27.93 ± 10.47                   | 13.54 ± 5.64                  | 90.13 ± 20.12 |
| **F**                    | 3.21          | 6.45*               | 3.13                            | 2.78                          | 7.44*         |
| **Educational level**    |               |                     |                                 |                               |               |
| Junior Middle School     | 20.65 ± 8.99  | 21.78 ± 9.75        | 28.34 ± 5.23                    | 39.47 ± 5.87                  | 88.43 ± 17.54 |
| Senior School            | 24.74 ± 10.43 | 25.01 ± 11.23       | 26.23 ± 4.99                    | 27.03 ± 5.23                  | 89.54 ± 18.56 |
| College                  | 30.56 ± 11.12 | 32.43 ± 11.89       | 24.65 ± 5.23                    | 25.46 ± 5.72                  | 91.67 ± 19.32 |
| **F**                    | 19.67**       | 20.52*              | 6.34*                           | 7.02*                         | 1.03          |
| **Type of diagnosis**    |               |                     |                                 |                               |               |
| Male Factor              | 26.54 ± 10.23 | 23.34 ± 9.35        | 27.56 ± 6.54                    | 24.67 ± 7.58                  | 92.43 ± 18.86 |
| Female Factor            | 21.21 ± 9.45  | 28.65 ± 10.54       | 24.32 ± 5.76                    | 29.56 ± 5.43                  | 89.54 ± 18.43 |
| Combined Factor          | 26.45 ± 8.65  | 27.96 ± 9.87        | 26.75 ± 5.32                    | 26.88 ± 6.34                  | 92.31 ± 19.32 |
| Unexplained              | 21.45 ± 9.04  | 23.56 ± 10.54       | 24.54 ± 4.89                    | 25.01 ± 5.43                  | 90.34 ± 19.04 |
| **F**                    | 7.83*         | 3.56                | 6.75*                           | 7.32*                         | 1.05          |
| **Previous treatment**   |               |                     |                                 |                               |               |
| No                       | 25.41 ± 10.24 | 26.03 ± 10.62       | 25.36 ± 10.28                   | 25.54 ± 11.03                 | 88.68 ± 18.36 |
| Yes                      | 26.89 ± 11.12 | 27.11 ± 11.08       | 26.32 ± 11.26                   | 27.03 ± 10.89                 | 89.82 ± 20.02 |
| **F**                    | 2.57          | 3.12                | 2.20                            | 2.38                          | 1.21          |
| **Infertility treatment period** | |                   |                                 |                               |               |
| ≤ 1 year                 | 22.92 ± 8.73  | 24.71 ± 7.89        | 24.21 ± 6.12                    | 26.93 ± 7.81                  | 89.41 ± 18.76 |
| > 1 year                 | 26.51 ± 8.42  | 26.83 ± 8.33        | 28.12 ± 6.27                    | 29.32 ± 6.21                  | 92.76 ± 19.71 |
| **F**                    | 8.15*         | 3.21                | 6.83*                           | 7.44*                         | 1.98          |

*p < 0.05; **p < 0.01.
The final 27-item version of FPI-SF showed a satisfactory fit of the data structure with the theoretical model of the test and an excellent internal consistency, offering the further relevant advantages of being a synthetic and abbreviated valid version of FPI for use in clinical practice and research. In this perspective, the analysis of convergent validity of FPI-SF revealed significant associations of all its subscales scores with perceived levels of State Anxiety, Depression, and Dyadic Adjustment in the expected directions, and the discriminant validity analyses confirmed that all scales assessed different but connected dimensions of infertility-related stress. Finally, the FPI-SF allowed the assessment of all infertility-related stress dimensions of the construct differentiated by individual characteristics of gender, age, educational level, and by infertility-related characteristics of type of diagnosis and duration of infertility.

In particular, data provided important information from a clinical point of view, highlighting several differences in stress dimensions by gender and type of diagnosis, the protective role of educational level and the duration of infertility treatment period as significant risk factor. In this perspective, the FPI-SF could be usefully applied to assess risk and protective factors and to define more focused interventions.

Despite these merits, some limitations need to be underlined. First, the test–retest reliability of the FPI-SF was not covered in this study, so that actually it is not possible to evaluate the temporal stability of our measures. Second, the study revealed some significant effects of individual characteristics and infertility-related characteristics that should be object of further analysis and investigations. Moreover, further studies should be developed to better explore the effects of responsiveness to treatments (i.e. success or failure of treatments) on infertile patients’ perceived levels of stress. Finally, considering that cultural and social variables may influence quality and intensity of infertility-related stress dimensions, future studies should be conducted using the FPI-SF with different infertile populations.

Despite these limitations, the FPI-SF constitutes a synthetic, reliable and valid multidimensional measure to assess stress dimensions among infertile patients in clinical practice and research, to define evidence-based interventions aiming to reduce infertility-related stress, non-compliance and discontinuation in Assisted Reproduction Treatment, and to promote individual and couples’ psychological health in infertile patients.

Acknowledgements
The authors wish to thank all the study participants for completing the questionnaire.

Declaration of conflicting interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding
The author(s) received no financial support for the research, authorship and/or publication of this article.

References
Aarts JWM, Huppelschoten AG and van Empel IWH (2012) How patient-centred care relates to patients’ quality of life and distress: A study in 427 women experiencing infertility. Human Reproduction 27(2): 488–495.
Abbey A, Andrews F and Halman L (1991) Gender’s role in response to infertility. Psychology of Women Quarterly 15(2): 295–316.
Benvenuti P, Ferrara M, Niccolai C, et al. (1999) The Edinburgh Postnatal Depression Scale: Validation for an Italian sample. Journal of Affective Disorders 53(2): 137–141.
Bernstein J, Potts N and Matlox J (1985) Assessment of psychological dysfunction associated with infertility. Journal of Obstetrics, Gynecology and Neonatal Nursing 14(6 Suppl.): 63s–66s.
Boivin J and Schmidt L (2005) Infertility-related stress in men and women predicts treatment outcome 1 year later. Fertility and Sterility 83(6): 1745–1752.
Boivin J, Bunting L, Collins JA, et al. (2007) International estimates of infertility prevalence and treatment-seeking: Potential need and demand for infertility medical care. Human Reproduction 22(6): 1506–1512.
Briggs SR and Cheek JM (1986) The role of factor analysis in the development and evaluation of personality scales. Journal of Personality 54(1): 106–148.
Browne MW (2001) An overview of analytic rotation in exploratory factor analysis. Multivariate Behavioral Research 36(1): 111–150.
Clark LA and Watson D (1995) Constructing validity: Basic issues in objective scale development. Psychological Assessment 7(3): 309–319.
Cohen J (1988) Statistical Power Analysis for the Behavioral Sciences (2nd edn). Hillsdale, NJ: Erlbaum.
Collins A, Freeman EW, Boxer AS, et al. (1992) Perceptions of infertility and treatment stress in females as compared with males entering in vitro fertilization treatment. Fertility and Sterility 57(2): 350–356.
Cooper BC, Gerber JR, McGettrick AL, et al. (2007) Perceived infertility-related stress correlates with in vitro fertilization outcome. Fertility and Sterility 88(3): 714–717.
Costello AB and Osborne JW (2005) Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical Assessment, Research & Evaluation 10(7): 1-9.
Csemiczky G, Landgren BM and Collins AT (2000) The influence of stress and state anxiety on the outcome of IVF-treatment: Psychological and endocrinological assessment of Swedish women entering IVF-treatment. Acta Obstetricia et Gynecologica Scandinavica 79(2): 113–118.
Daniluk JC and Hurtig-Mitchell J (2003) Themes of hope and healing: Infertile couples’ experiences of adoption. Journal of Counseling and Development 81(4): 389–399.
Donarelli Z, Gullo S, Lo Coco G, et al. (2015) Assessing infertility-related stress: The factor structure of the Fertility Problem Inventory in Italian couples undergoing infertility treatment.
Lykeridou K, Gourounti K, Deltsidou A, et al. (2009) The impact of infertility on psychological well-being, marital relationships, sexual relationships, and quality of life of couples. Fam. Proc. 48: 107–116.

Glover L, Hunter M, Richards JM, et al. (1999) Development of the Resilience in infertility scale. Fertility and Sterility 72(4): 623–628.

Gourounti K, Anagnostopoulos F and Vaslamatzis G (2011) Psychometric properties and factor structure of the Fertility Problem Inventory in a sample of infertile women undergoing fertility treatment. Midwifery 27(5): 660–667.

Herrmann D, Scherg H, Verres R, et al. (2011) Resilience in infertile couples acts as a protective factor against infertility-specific distress and impaired quality of life. J. Assisted Reproduction and Genetics 28(11): 1111–1117.

Hu L and Bentler PM (1998) Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. Psychological Methods 3(4): 424–453.

Huppelschoten AG, van Dongen AJCM, Verhaak CM, et al. (2013) Differences in quality of life and emotional status between infertile women and their partners. Hum. Reproduction 28(8): 2168–2176.

ISTAT (2015) Annual Report 2014. Roma: The State of the Nation.

Kim HJ and Shin HS (2014) Validation of a Korean version of the Fertility Problem Inventory. Asian Nursing Research 8(3): 207–212.

Lazarus R and Folkman S (1984) Stress, Appraisal and Coping. New York: Springer.

Luk BH and Loke AY (2015) The impact of infertility on the psychological well-being, marital relationships, sexual relationships, and quality of life of couples: A systematic review. J. Sex Marital Ther. 41(6): 610–625.

Lykeridou K, Gourounti K, Detsidou A, et al. (2009) The impact of infertility diagnosis on psychological status of women undergoing fertility treatment. J. Reproductive and Infertility Psychology 27(3): 223–237.

Monga M, Alexandrescu B, Katz SE, et al. (2004) Impact of infertility on quality of life, marital adjustment, and sexual function. Urology 63(1): 126–130.

Moura-Ramos M, Gameiro S, Canavarro MC, et al. (2012) Assessing infertility stress: Re-examining the factor structure of the Fertility Problem Inventory. Human Reproduction 27(2): 496–505.

Murray D and Cox JL (1990) Screening for depression during pregnancy with the Edinburgh Depression Scale (EDDS). J. Reproductive and Infertility Psychology 8(2): 99–107.

Nelson CJ, Shindel AW, Naughton CK, et al. (2008) Prevalence and predictors of sexual problems, relationship stress, and depression in female partners of infertile couples. J. Sexual Medicine 5(8): 1907–1914.

Newton CR, Sherrard W and Glavac I (1999) The Fertility Problem Inventory: Measuring perceived infertility-related stress. Fertility and Sterility 72(1): 54–62.

Onat G and Beji NK (2012) Marital relationships and quality of life among couples with infertility. Sexualidad and Disability 30(1): 39–52.

Ozkan S, Karabulut A, Oğuz N, et al. (2015) Coping with the stress of infertility. Males versus females. J. Reproductive Medicine 60(7–8): 339–344.

Pedrabissi L and Santinello M (1989) STAI State-Trait Anxiety Inventory, Forme Y: Manuale [STAI Inventory for State and Trait Anxiety, Form Y: Manual]. Firenze: Organizzazioni Speciali.

Peng T, Coates R, Merriman G, et al. (2011) Testing the psychometric properties of Mandarin version of the fertility problem inventory (M-FPI) in an infertile Chinese sample. J. Psychosomatic Obstetrics & Gynecology 32(4): 173–181.

Peterson BD, Newton CR and Feingold T (2007) Anxiety and sexual stress in men and women undergoing infertility treatments. Fertility and Sterility 88(4): 911–914.

Peterson BD, Newton CR and Rosen KH (2003) Examining congruence between partners’ perceived infertility-related stress and its relationship to marital adjustment and depression in infertile couples. Family Process 42(1): 59–70.

Peterson BD, Sejaek CS, Pirritano M, et al. (2013) Are severe depressive symptoms associated with infertility-related distress in individuals and their partners? Human Reproduction 29(1): 76–82.

Pook M, Rohrle B and Krause W (1999) Individuals prognosis for changes in sperm quality on the basis of perceived stress. Psychotherapy and Psychosomatics 68(2): 95–101.

Repokari L, Punamaki RL, Unkila-Kallio L, et al. (2007) Infertility treatment and marital relationships: A one-year prospective study among successfully treated IART couples and their controls. Human Reproduction 22(5): 1481–1491.

Sexton MB, Byrd MR and von Kluge S (2010) Measuring resilience in women experiencing infertility using the CD-RISC: Examining infertility-related stress, general distress, and coping styles. J. Psychiatric Research 44(4): 236–241.

Shindel AW, Nelson CJ, Naughton CK, et al. (2008) Sexual function and quality of life in the male partner of infertile couples: Prevalence and correlates of dysfunction. J. Urol. 179(3): 1056–1059.

Sijtsma K and Van der Ark LA (2017) A tutorial on how to do a Mokken scale analysis on your test and questionnaire data. British J. Mathematical and Statistical Psychology 70: 137–158.

Spanier GB (1976) Measuring dyadic adjustment: New scales for assessing the quality of marriage and similar dyads. J. Marriage and the Family 38(1): 15–28.

Spielberger C (1972) Anxiety: Current Trends in Research. London: Academic Press.

Stanton AL, Tennen H, Affleck G, et al. (1991) Cognitive appraisal of infertility stress, and coping styles. J. Psychiatric Research 25(4): 236–241.

Stechl J, Jones PB and Croudace TJ (2012) Mokken scale analysis on your test and questionnaire data. International J. Medical Education 2: 53–55.

Williams KE, Marsh WK and Rasgon NL (2007) Mood disorders and fertility in women: A critical review of the literature and
implications for future research. *Human Reproduction* 13(6): 607–616.

Wischmann T and Thorn P (2013) (Male) infertility: What does it mean to men? New evidence from quantitative and qualitative studies. *Reproductive BioMedicine Online* 27(3): 236–243.

Wischmann T, Stammer H, Scherg H, et al. (2001) Psychosocial characteristics of infertile couples: A study by the ‘Heidelberg Fertility Consultation Service’. *Human Reproduction* 16(8): 1753–1761.

Yazdani F, Kazemi A, Fooladi MM, et al. (2016) The relations between marital quality, social support, social acceptance and coping strategies among the infertile Iranian couples. *European Journal of Obstetrics & Gynecology and Reproductive Biology* 200: 58–62.

Zegers-Hochschild F, Adamson GD, de Mouzon J, et al. (2009) The International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary on ART terminology. *Fertility and Sterility* 92(5): 1520–1524.