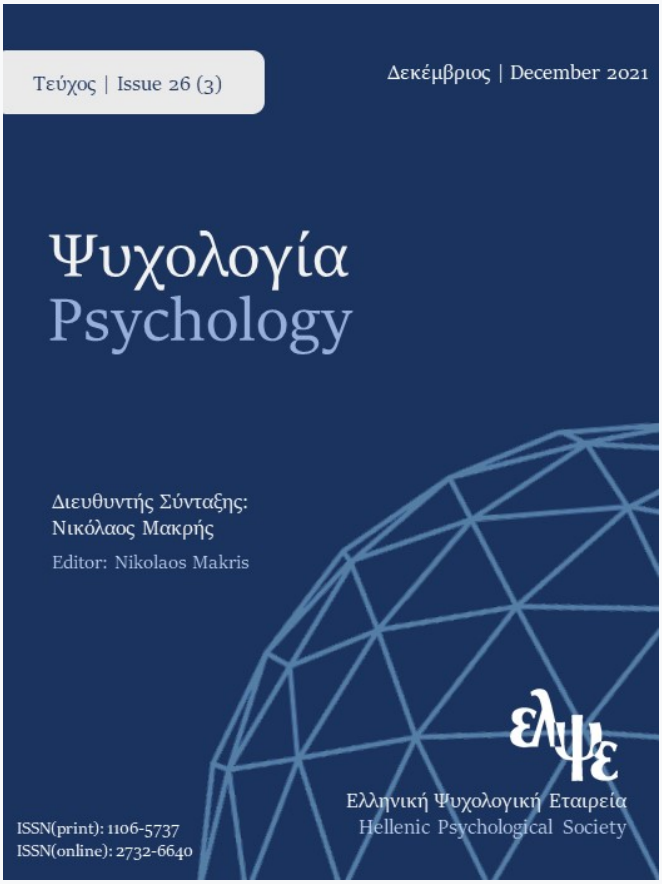
Psychology: the Journal of the Hellenic Psychological Society

Vol 26, No 3 (2021)

Special Section: Psychological consequences of the COVID-19 pandemic



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doi: 10.12681/psy_hps.28853

To cite this article:

Kyriazos, T., Galanakis, M., Karakasidou, E., & Stalikas, A. (2021). Modeling the protective effects of Positive Emotions against Depression during early COVID-19 quarantine, with a structural equation model (SEM). *Psychology: The Journal of the Hellenic Psychological Society*, *26*(3), 1–20. https://doi.org/10.12681/psy_hps.28853

ΨΥΧΟΛΟΓΙΑ | PSYCHOLOGY, 26 (3), 1-20

Ελληνική Ψυχολογική Εταιρεία
Hellenic Psychological Society

ΕΜΠΕΙΡΙΚΗ ΕΡΓΑΣΙΑ | RESEARCH PAPER

Modeling the protective effects of Positive Emotions against Depression during early COVID-19 quarantine, with a structural equation model (SEM)

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KEYWORDS

Broaden and Build Theory
COVID-19
depression
life satisfaction
positive emotions
resilience
SEM

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ABSTRACT

Amidst COVID-19 pandemic, focusing on effective coping strategies is crucial for building resilience to alleviate COVID-19 distress. The purpose of this study was to examine whether positive emotions and resilience mediate the relationship between COVID-19 depression and life satisfaction, controlling for the effect of creative activities and income on depression and non-parenthood on life satisfaction. The study was carried out during the early COVID-19 quarantine in a Greek sample of the general population (N = 759). The following measures were used: Depression, Anxiety and Stress Scale, Short (DASS 9), the Scale of Positive and Negative Experience short (SPANE 8), the Satisfaction with Life Scale (SWLS), and the Brief Resilience Scale (BRS). Structural equation modeling (SEM) was used to analyze the data. The measurement model had a good fit with adequate model-based reliability, convergent, and discriminant validity. Full measurement invariance to the strict level was established across gender for the measurement model. In parallel, the full SEM model had an equally good fit. Five hypotheses were supported, and one was rejected. Positive emotions and resilience mediated the relationship between COVID-19 depression and life satisfaction, i.e. positive emotions increased life satisfaction within the distressful COVID-19 context by building resilience with moderate effects. The effect of COVID-19 depression on life satisfaction before the mediation effect was -.57, $p < .001$ (32% explained variance on life satisfaction). After adding the mediation of positive emotions and resilience, the effect of COVID-19 depression on life satisfaction dropped to -.25, $p < .001$ (43% explained variance on life satisfaction).

Introduction

After World Health Organization categorized COVID-19 as a pandemic (WHO, 2020), protective measures like physical distancing were taken worldwide to control COVID-19 infectivity (Tian et al., 2020). In Greece, after the first COVID-19 case on February 26, 2020, containment measures were taken on February, 28 at a local level and on March 23 at a national level. On May 4th containment measures (i.e. quarantine) were progressively relaxed and by the end of June 2020 they were removed almost completely.

During this COVID-19 quarantine context, this study focused on examining how positive emotions affect life satisfaction through building resilience during the early COVID-19 containment measures, within the negative effect of early COVID-19 depression. The study rationale was as follows: (A) COVID-19 poses a threat to the mental

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health of the quarantined individuals (Hyland et al., 2020), associated with higher depression (e.g. García-Dantas et al., 2020), as described in the Introduction section "*The Distressful early COVID-19 Context*". (B) Depression depletes life satisfaction of the quarantined individuals (Holmes et al., 2020), as suggested in the section "*Depression Negatively Predicts Life Satisfaction*". (C) However, positive emotions build resilience and other psychological resources that may increase life satisfaction (basic principle of the Broaden-and-build theory, Fredrickson, 1998, 2001) indirectly through resilience, as proposed in the Introduction section "*Positive Emotions Increase Life Satisfaction by Building Resilience (Indirectly)*", and (D) Beyond indirect effect, positive emotions increase life satisfaction also directly, as suggested in the section "*Positive emotions Increase Life Satisfaction (Directly)*". Findings may have implications for efforts to build coping strategies during COVID-19 pandemic, and to sustain depleted life satisfaction (Holmes et al., 2020).

The Distressful early COVID-19 Context

Containment measures may be an effective public health measure against COVID-19, nevertheless, they threat the mental health of the quarantined individuals (Hyland et al., 2020). Evidence from this early pandemic phase suggested that containment measures were associated with depression in the general population. In Ireland, there was a 23% prevalence of depression (Hyland et al., 2020). In the UK depression prevalence was 22% (Hyland et al., 2020). Italians perceived 67% moderate depression, 17% severe, or 16% extremely severe (Mazza et al., 2020). Finally, in Spain, they perceived 22% moderate, severe or extremely severe depression (García-Dantas et al., 2020). So, research on what resources could mitigate the effect of depression on life satisfaction is vital (Holmes et al., 2020) for building effective coping strategies within the distressful early COVID-19 context. The same is true for resources that build resilience to increase life satisfaction and alleviate containment distress (Holmes et al., 2020).

Depression Negatively Predicts Life Satisfaction

The negative relation of depression to life satisfaction was examined by several studies (Blais et al., 1989; Schimmack et al., 2004).

Their association bears similarities to absence of positive affect (Siedlecki et al., 2008) and it is across gender and throughout the lifespan (Gigantesco et al., 2020). More than that, depression was found to have predictive power on life satisfaction (Arrindell et al., 1991; Diener et al., 1999; Pavot & Diener, 2008; Siedlecki et al., 2008). Specifically, depression is a negative predictor of life satisfaction (Bukhari & Saba, 2017; Leung et al., in press; Siedlecki et al., 2008). Depression, anxiety, and stress negatively predicted the life satisfaction of university students (Bukhari & Saba, 2017) and older people living in sheltered housing (Leung, et al., in press).

Positive Emotions Increase Life Satisfaction by Building Resilience (Indirectly)

Positive emotions increase life satisfaction by building resilience (Cohn et al., 2009; Fredrickson et al., 2008). Additionally, Positive emotions can build resilience, and generate novel thinking, and creativity (Cohn et al., 2009). A meta-analysis on resilience and mental health (Hu et al., 2015) suggested that resilience had a positive association with life satisfaction and positive emotions and a negative one with depression. Positive emotions can broaden awareness (Fredrickson, 1998, 2001; Fredrickson & Branigan, 2005; Isen, 2004; Wadlinger & Isaacowitz, 2006), an overlooked attribute (Fredrickson & Levenson, 1998) by past emotional models (e.g. Ekman, 1992; Lazarus, 1991; Levenson, 1994). Broadened awareness conveys indirect coping benefits for life satisfaction by building resilience and other physical, intellectual, and social resources (Cohn et al., 2009; Fredrickson & Branigan, 2005; Fredrickson & Levenson, 1998; Fredrickson et al., 2000; Fredrickson, et al., 2008). In times of hardship resilience built (along with other resources) can fuel a bounce-back amidst adversity (Folkman, 1997; Fredrickson, 2013; Taylor et al., 2000).

Studies on positive emotions in the aftermath of crises (September 11th, 2001) showed that positive emotions buffered resilient people against depression and fueled coping strategies (Fredrickson et al., 2003). Amidst crisis positive emotions prospectively predicted resilience by increasing life satisfaction, and these effects were present despite negative emotions (Fredrickson et al., 2003; Cohn et al., 2009). Other prospective studies (Cohn et al., 2009) showed that positive emotions increased life satisfaction by building resilience. That is, change in resilience mediated the association between positive emotions and increased life satisfaction, suggesting that life satisfaction can be attributed to positive emotions through resource development (Cohn et al., 2009). Shi, Wang, Bian & Wang (cross-sectional study; 2015) also reported that resilience mediated the relationship between stress and life satisfaction among Chinese medical students. Positive emotions predicted resilience and self-motivation towards physical education classes in a Spanish sample of adolescents as modeled with SEM (cross-sectional study; Trigueros et al., 2019).

Folkman (2008) confirmed that positive emotions are important for rebounding from stress, especially in the sustainability of the coping process, and the use of adaptive coping strategies.

Positive emotions Increase Life Satisfaction (Directly)

Fredrickson et al. (2008) based on experimental prospective data processed with latent growth models, found that the direct effect from change in positive emotions, to change in life satisfaction was not significant, and when it was included, it did not improve the model fit. Fredrickson et al. (2008) argued that changes in positive emotions only produced changes in life satisfaction to the extent that they built personal resources and this unique contribution of positive emotions highlight the conceptual distinction between transient positive emotions experience and global life quality judgments (Cohn et al., 2008; Diener et al., 2006). Additionally, drawing on more evidence from the broaden and build theory of positive emotions (Fredrickson 1008, 2001), positive emotions predict an increase in life satisfaction but when momentary positive emotions were tested separately from general life satisfaction, only positive emotions remained predictive (Cohn et al., 2009).

Creative Activities, Income, and Children During Early COVID-19 Containment Measures

The relationship of perceived creative activities with dysfunctional contexts seems plausible for the early COVID-19 quarantine. Kapoor and Kaufman (2020) reported that creative activities during the quarantine buffered against the negative effects of the pandemic context. Similarly, a study on a French sample (Mercier et al. 2021) reported a significant increase in everyday creative activities during the quarantine. Likewise, employees from China, Germany, and the United States perceiving more creative growth during COVID-19 reported higher flourishing (Tang et al., 2021). Creative activities could buffer against depression during quarantine (H5), a pattern that verified for early COVID-19 quarantine with Machine Learning (Kyriazos, Galanakis, Karakasidou, Stalikas, 2021a).

In contrast, financial uncertainty and unemployment are risk factors for depression during quarantine (DiGiovanni et al., 2004; Mazza, et al., 2020; Tracy et al., 2009; Van Bortel et al., 2016). Using Machine Learning models, income was ranked the second most important variable (after perceived creative activities) for experiencing subjective wellbeing during the early COVID-19 quarantine (Kyriazos, et al., 2021a).

Finally, children are associated with lower life satisfaction (Hefferon & Boniwell, 2011). Prior research (Taylor et al., 2008), suggested that parenthood during a pandemic was associated with more negative psychological outcomes than non-parenthood.

The present study

In agreement with the above body of literature, a SEM research model was specified to study how positive emotions and resilience mediate between depression and life satisfaction of the general Greek population during the early COVID-19 restriction measures.

Initially, we planned to specify a model testing the direct negative effect of COVID-19 depression on life satisfaction. Then looking for coping strategies against COVID-19 distress on Life Satisfaction, we intended to test with parallel and serial mediation if positive emotions increase life satisfaction by building resilience (basic principle of Broaden and Build theory; Fredrickson 1998, 2001).

Five hypotheses were formulated (H1 – H5). Two of them (H4 – H5) focus on the effect of demographic variables during the early COVID-19 quarantine. The research model is presented in Figure 1.

H1 Depression during COVID-19 containment measures has a significant, direct negative effect on positive emotions (path c in Figure 1).

H2 Positive emotions during the early COVID-19 containment have a significant, direct positive effect on life satisfaction by building resilience (path d and b2 in Figure 1, parallel and serial mediation between depression and life satisfaction)

H3 Positive emotions during the early COVID-19 containment measures have a significant, direct positive effect on life satisfaction (path b1 in Figure 1)

H4. Greater engagement with perceived creative activities and higher income during the early COVID-19 containment measures have a significant, direct negative effect on depression (path e and f).

H5. Not having children during the early COVID-19 containment measures has a significant, direct positive effect on life satisfaction (path g).

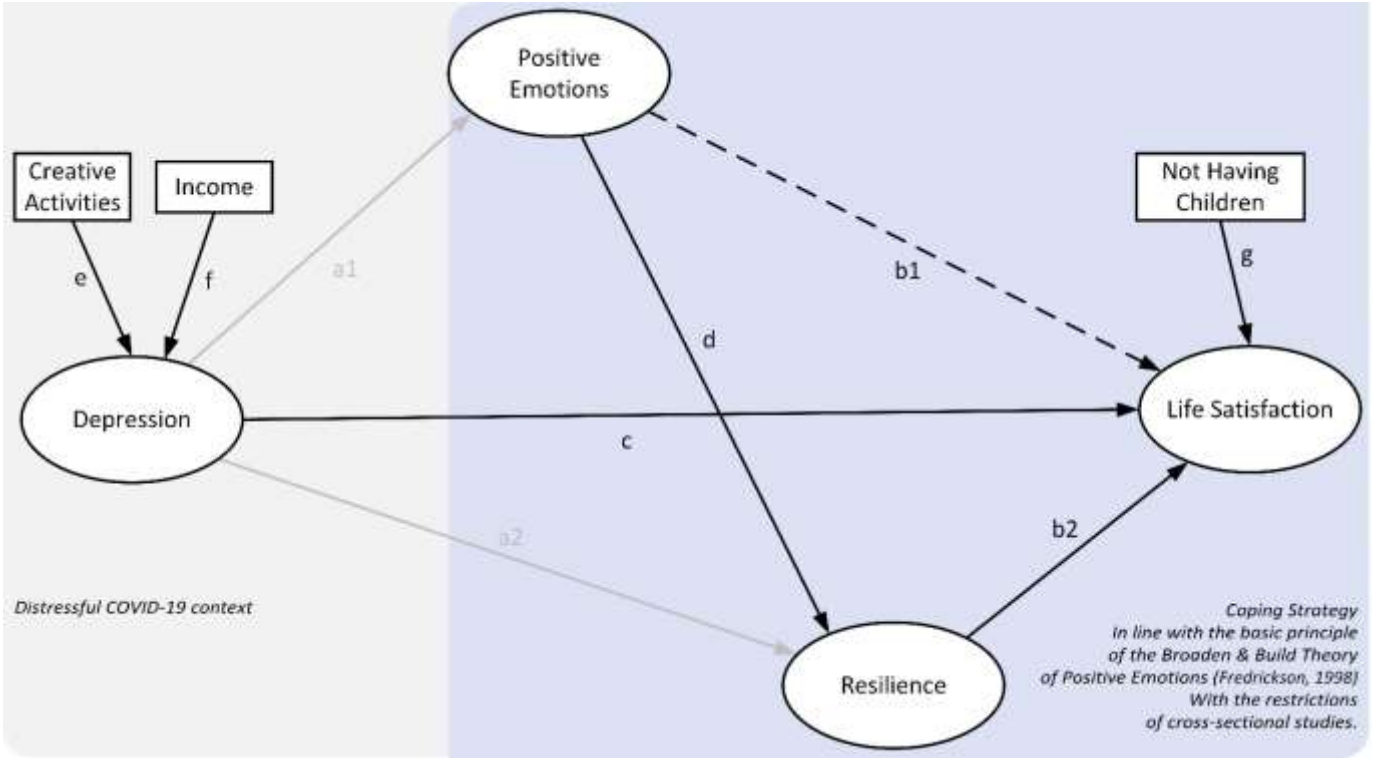

Figure 1. The paths of the research model. Depression = DASS-D, Positive Emotions = SPANE-P, Resilience = BRS, Life satisfaction = SWLS

Method

Participants

The sample involved 759 adults (78% females). The 25%, was 18-40 years, 42% was 41-60 years, 3% was 61-70 years and 1% was over 70. Almost half of the respondents were single (47%), married/living together (40%), divorced/widowed (13%). A 59% did not have children. Most respondents had a BA (42%), or lower (13%). 41% had MA or higher (5%). The 31% were private-sector employees, civil servants (26%), self-employed (17%), students (10%), jobless (7%), retired (4%), other (6%). Monthly income varied from no income (13%), ≤ 600€ (13%), 601-1200€ (41%), 1201-1800€ (21%), >2500€ (13%). There were 98.8% of no-COVID cases. Respondents' families included 97.5% no-COVID cases. The 84% did not have vulnerabilities but 64% had a vulnerable family member. The participants rated the degree they were engaged in perceived creative activities during the quarantine. The 16% perceived none or low engagement, 26% was neutral and 58% perceived high or very high engagement.

Measures

Depression Anxiety Stress Scale (DASS-9). This is a briefer version of DASS-21 (Kyriazos, Stalikas, Prassa, & Yotsidi, 2018a; Lovibond & Lovibond, 1995; Yusoff, 2013) with 3 items per factor (Depression, Anxiety, Stress), instead of 7. Items are rated on a 4-point scale (0 = *Did not apply to me at all* to 3 = *Applied to me very much, or most of the time*). The higher the score the more intense/frequent the distress. In this study internal consistency reliability for the three DASS factors was α = .65 (Depression), .78 (Anxiety), .63 (Stress) [95% CI = .61, .69]. The model-based reliability (McDonald, 1999) was ω = .70 (Depression), .79 (Anxiety) and .64 (Stress), indicating adequate reliability (see Kyriazos, 2017a; Kyriazos, 2017b). Model-based convergent validity, calculated with Average Variance Extracted (AVE; Fornell & Larcker, 1981) was .44 (Depression), .55 (Anxiety) and .38 (Stress).

Scale of Positive and Negative Experience 8 (SPANE-8). SPANE-8 (Kyriazos, Stalikas, Prassa, & Yotsidi, 2018b; Diener et al., 2010) is a shorter version of SPANE-12 with 4 items per factor (Positive Experiences, Negative Experiences) instead of 8 in the original (Diener et al., 2010, p.145). Two general items with the lowest CFA factor loadings were excluded (Kyriazos et al. 2018b). Items are rated on a 5-point Likert scale (1 = *Very Rarely or Never* to 5 = *Very Often or Always*, midpoint = *Sometimes*). In this study internal consistency reliability for the bifactorial SPANE structure was α = .88 (Positive Experiences or SPANE-P), .79 (Negative Experiences or SPANE-N), [95% CI = .87, .89]. The model-based reliability (McDonald, 1999) was ω = .88 (SPANE-P), .79 (SPANE-N), indicating adequacy. Model-based convergent validity, calculated with AVE was .65 (SPANE-P), and .49 (SPANE-N) indicating adequate convergent latent factors.

The Brief Resilience Scale (BRS). BRS (Smith et al., 2008; Kyriazos, Stalikas, Prassa, Galanakis, Yotsidi, & Lakioti, 2018) contains 6 items measuring the ability to bounce back from stress and difficulties (e.g., "*I usually come through difficult times with little trouble*"). The items are rated on a 5-point Likert scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*), midpoint = *Neutral*. The possible score ranges from 1 (minimum resilience) to 6 (maximum resilience). Three items are reversed scored. In this study internal consistency reliability for the unifactorial BRS structure was α = .83 [95% CI = .81, .85]. The model-based reliability (McDonald, 1999) was adequate, ω = .83. Model-based convergent validity was AVE = .45 indicating marginal convergence.

Satisfaction with Life Scale (SWLS). The SWLS (Diener et al., 1985) is a unidimensional measure of perceived global satisfaction with life on a 7-point scale, from 1 (*Strongly Disagree*) to 7 (*Strongly Agree),* midpoint = *Neither Agree nor Disagree*. The score ranges from 1 (Extremely dissatisfied) – 35 (Extremely satisfied). In this study internal consistency reliability for the unifactorial SWLS structure was α = .87 [95% CI = .85, .88]. The

model-based reliability (McDonald, 1999) was adequate, ω = .87. Model-based convergent validity, was AVE = .56, indicating satisfactory convergence.

Control Variables. Three variables were set as controls: (a) Engagement with perceived creative activities during the quarantine answered on a 5-point Likert scale from (1 = *Not at all*, 3 = *Neither slightly nor strongly*, 5 = *Very strongly*); (b) Income *(1 =none, 5= >2500€ per month)* and (c) Having children *(1= yes, 2= no)*. See Participants' section for details on frequencies for the control variables.

Procedure

This is a cross-sectional design. Data was collected with the network sampling method, an alternative for the snowball sampling for community samples (APA, 2014). Data were collected digitally via a web-link hosted on webpages and Facebook accounts. The test-battery fields were set as "*required*" to minimize non-response (Stalikas & Kyriazos, 2019). The study was available online from April, 5th until May 4th, 6:30 A.M.

Analytic Strategy

An overview of the study analyses is presented in Table 1.

Table 1

Description of the Analyses Performed

Analysis	Description	Rationale
1	Multivariate Normality Test with Multiple tests	To test for the multivariate normality assumption with Mardia's multivariate kurtosis and skewness, Henze–Zirkler's consistent test, Doornik–Hansen omnibus test, and Energy test.
2	Detecting outliers	To detect outliers with Mahalanobis distance.
3	Test the SEM measurement model fit and indicator reliability	To evaluate the measurement model fit with a CFA and to evaluate Reliability of the measurement variables.
4	Measurement model, Reliability and Validity of the latent variables	To evaluate the Composite Reliability (CR; Werts, Linn & Joreskog 1974; ωt coefficient; McDonald, 1999) and Average Variance Extracted (AVE; Fornell & Larcker, 1981), Maximum Shared Variance (MSV) and Average Shared Variance (ASV), evidencing model-based convergent and discriminant validity.
5	Cross-validating Measurement model Discriminant Validity with additional methods	To evaluate model-based discriminant validity further with the Fornell & Larcker criterion (1981) and the HTMT Ratio of Correlation Method (Henseler & Ringle & Sarstedt, 2015).
6	Full measurement invariance of the SEM measurement model	To test if the measurement model has invariant factors, factor loadings, intercepts, and residuals across male and female respondents.
7	Test the full SEM model fit	To evaluate if the structural model fit is adequate.
8	A priori & post hoc power analysis of the full SEM model	To evaluate the sample required for achieving a power of 80% to reject a wrong model. An alpha level of .05 was assumed with an RMSEA misspecification of .05 (Hancock and Freeman, 2001; MacCallum, Browne, & Sugawara, 1996; see Kline 2016).
9	Hypotheses testing with three controls (H1-H5)	To test the hypothesized relationships between latent variables with 4 direct associations, and 1 mediation. Three hypotheses used controls.

*Note. Data were analyzed with R version 4.0.2. (R Development Core Team, 2020)

Results

Preliminary Analysis

They were no missing values (see Procedure section). Multivariate normality was examined with Mardia's multivariate kurtosis and skewness tests, Henze–Zirkler's consistent test, Doornik–Hansen Omnibus test, and Energy test (see Korkmaz et al., 2014). The multivariate normality tests were significant, $p < .001$. There were 23 multivariate outliers, D^2 critical value $\chi^2[18] = 42.31$, $p < .001$. There was no reason to remove outliers since they did not weaken findings, $N = 759$.

The Measurement Model

DASS-9 Depression, SPANE-8 Positive, BRS, and SWLS were the latent variables included in the measurement model. Model fit was evaluated with RMSEA (≤ .06, 90% CI), SRMR (≤ .08), CFI (≥ .95), TLI (≥ .95), (Brown, 2015; Hu & Bentler, 1999).

The fit of the SEM measurement model was good, $\chi^2(129) = 267.52$ ($p = .000$), CFI = .971, TLI = .966, RMSEA = .038 [90% CI = .032, .043], SRMR = .038. All standardized factor loadings (Table 2) stayed above.30 – .40 (Brown, 2015; Osborne & Costello, 2004; Tabachnick & Fidell, 2013), ranging from .370–.882. The R^2 ranged from .137–.777. Interfactor correlations varied between │.466│ and │.672│. The factor loadings of the observed variables were higher on their assigned latent variable than on the other latent variables (Table 2).

Table 2
Standardized Loadings (λ), and R squared for the SEM Measurement Model, (*N* = 759)

Latent Variable	Observed Variable	λ*	R^2	Latent Variable	Observed Variable	λ*	R^2
DASS-9 D				SPANE_P			
	DASS9_1_D	.370	.137		SPANE8_2_P	.842	.710
	DASS9_5_D	.775	.600		SPANE8_3_P	.845	.714
	DASS9_9_D	.762	.581		SPANE8_6_P	.763	.582
BRS					SPANE8_8_P	.779	.607
	BRS_1	.738	.545	SWLS			
	BRS_2_R	.647	.419		SWLS_1	.838	.702
	BRS_3	.628	.395		SWLS_2	.743	.552
	BRS_4_R	.744	.553		SWLS_3	.882	.777
	BRS_5	.568	.322		SWLS_4	.749	.562
	BRS_6_R	.697	.486		SWLS_5	.622	.386

**p < .001, DASS-9 D = DASS-9 Depression, SPANE-8 = Scale of Positive and Negative Experience 8, BRS = Brief Resilience Scale, SWLS = Satisfaction with Life Scale*

Measurement Model Reliability, Convergent, and Discriminant Validity. Model-based convergent validity was tested with Composite Reliability (CR; Werts et al., 1974) and Average Variance Extracted (AVE; Fornell & Larcker, 1981). CR (ω_t coefficient; McDonald, 1999) ranged from .69 (DASS-9_D) to .88 (SPANE-8_P). AVE ranged from .44 (DASS-9_D) to .65 (SPANE-8_P); see Table 3. Moreover, Maximum Shared Variance (MSV; Fornell & Larcker, 1981) with the exception of DASS-9 D stayed below AVE and the same was true for all the Average Shared Variance (ASV; Fornell & Larcker, 1981), no exceptions. Implementing the Fornell & Larcker criterion, the square root of AVE for each latent variable (Table 3 diagonals in bold typeface) was compared to the maximum correlation between all the latent variables in the model (Table 3, highlighted cells below the diagonal), suggesting that the latent variables were sufficiently different. However, DASS-9–SPANE-8 P pair

showed an unacceptable difference, but of negligible magnitude (Rahim & Magner, 1995). Finally, the measurement model was also examined with the Heterotrait-Monotrait (HTMT) ratio of correlation (Henseler et al., 2015). Adopting the $HTMT_{0.85}$ criterion (Ab Hamid et al., 2017; Kline, 2011), the latent variables of the measurement model differed sufficiently (Table 3, highlighted cells above the diagonal).

Table 3

Estimates of Model-Based Reliability, Model-Based Convergent and Discriminant Validity for the Measurement Model, N = 759

Factors	CR	AVE	MSV	ASV	DASS-9_D	BRS	SPANE-8_P	SWLS
DASS-9_D	.69	.44	.45	.36	**.66**	.62	.68	.59
BRS	.83	.45	.31	.26	|.56|	**.67**	.48	.50
SPANE-8_P	.88	.65	.45	.33	|.67|	.47	**.81**	.56
SWLS	.87	.56	.33	.30	|.57|	.49	.57	**.75**

**Note*. Diagonals (in bold typeface) = √AVE, CR = Composite Reliability (ω_t, McDonald, 1999), AVE = Average Variance Extracted, MSV = Maximum Shared Variance, ASV =Average Shared Variance. (1) Convergent Validity: CR > AVE ≥ .5. (2) Discriminant Validity: MSV < AVE; ASV < AVE and √AVE > inter-item correlations. (3) Correlations for the Fornell & Larcker (1981) Method are in highlighted cells below diagonal and (4) HTMT: Heterotrait-Monotrait correlation ratio. HTMT values are in highlighted cells above diagonal

Measurement Model Invariance. The invariance of the measurement model was evaluated across gender (*N*=759*)*. The difference test criteria were |ΔCFI| < .01 (Cheung & Rensvold, 2002), and |ΔRMSEA| < .01, *N* =759 > 300 (Chen, 2007: *p*. 501). The measurement model was tested separately for each gender (N_{males}= 170, $N_{females}$ = 589). This baseline model had a good fit for males, $\chi^2(129) = 166.71$, CFI = .966, TLI = .960, RMSEA = .041 [90% CI = .022, .057], SRMR = .053. The fit was equally good for females, $\chi^2(129) = 253.43$, CFI = .968, TLI = .962, RMSEA = .040 [90% CI = .034, .047], SRMR = .042. The configural structure was verified (Model 1, Table 4). ΔCFI and ΔRMSEA suggested full weak, strong, and strict invariance (Models 2–4, Table 4).

Table 4

Goodness-of-Fit for the Nested Models to Test Full Measurement Invariance Across Gender for the SEM Measurement Model (N = 759)

						Difference in Fit	
Nested Models	**χ^2**	***df***	**CFI**	**RMSEA**	**Model Comparison**	**ΔCFI**	**ΔRMSEA**
Model 1. Configural Invariance	258.35	258	.967	.041	–	–	–
Model 2. Full Weak Invariance	441.41	272	.966	.041	Model 2 vs 1	-.001	.000
Model 3. Full Strong Invariance	457.67	286	.965	.040	Model 3 vs 2	-.001	-.001
Model 4. Full Strict Invariance	492.48	304	.962	.040	Model 4 vs 3	-.003	.000

**Note*. Estimator = MLR.

The Full SEM Model

Initially, we specified a model to test the direct negative effect of COVID-19 depression (DASS9-D) on life satisfaction (SWLS). Then, we added parallel and serial mediation, to test if positive emotions (SPANE-8 P) increase life satisfaction by building resilience (BRS), i.e. if positive emotions and resilience mediated between early COVID-19 depression and life satisfaction.

This model to test the direct relationship between DASS9-D, and SWLS (Figure 1A in the Appendix) showed a very good fit, $\chi^2(19) = 41.082$, p = .002, CFI = .989, TLI = .983, RMSEA = .039 [90% CI = .025, .053], SRMR = .023 (calculated with bias-corrected and accelerated CIs). The effect of depression (DASS9-D) on life satisfaction (SWLS) was β = -.569, p < .001. The explained variance on life satisfaction (SWLS) was 32%.

Then, parallel and serial mediation were added. This model (Figure 2A in the Appendix) testing the relationships between DASS9-D, SPANE8-P, BRS and SWLS, while statistically controlling for engagement with creative activities during quarantine, income and children showed an equally good fit, $\chi^2(180) = 438.85$, $p = .000$, CFI = .951, TLI = .944, RMSEA = .044 [90% CI = .047, .072], SRMR = .043 (calculated with bias-corrected and accelerated CIs).

A priori and post-hoc power analysis (Figure 2) based on RMSEA (Hancock and Freeman, 2001; MacCallum et al., 1996) was carried out. A priori power analysis suggested that a sample size of $N = 118$ ($< N = 759$) was required for achieving a power of approximately 80% to reject a wrong model ($df = 180$), RMSEA = .05, alpha = .05. Post hoc power analysis suggested that a sample size of $N = 759$ was associated with a power > 99.99% to reject a wrong model ($df = 180$), RMSEA = .05, alpha = .05 (Figure 2).

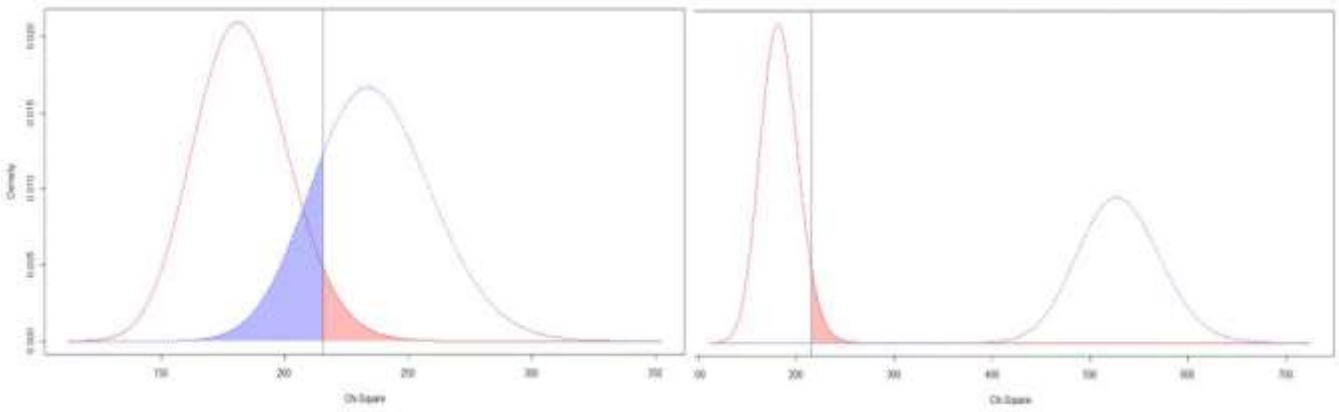

Figure 2. A priori (left) and post-hoc (right) power analysis based on RMSEA for the Structural SEM Model

Hypotheses testing. The structural results for the relationships of depression (DASS9-D), Positive emotions (SPANE8-P), Resilience (BRS), and Life Satisfaction (SWLS) while statistically controlling for engagement with creative activities during quarantine, income, and children are presented in Table 5 (path coefficients and their 95% CI) and in Figure 3 (structural model). Four hypotheses (H1-H4) were supported, and 1 (H5) was rejected (Table 5).

Path coefficients (Table 5) were estimated with 2 alternative specifications: the constrained and unconstrained error variance to evaluate their sensitivity. Parameter estimates and their SEs were nearly identical to all alternative specifications, suggesting robustness. Standardized path coefficients revealed that the significant negative effect of depression (DASS9-D) on life satisfaction (SWLS) was mediated by positive emotions (SPANE8-P) and resilience (BRS), see Figure3.

Indirect and total effect estimates and their 95% CI, are presented in Table 6. The total effect of depression (DASS9-D) and positive emotions (SPANE8-P) on life satisfaction (SWLS) was -1.779 and .481 respectively.

The explained variance on life satisfaction (SWLS) was 43%.

Table 5

Structural Results of the Proposed Full SEM Model (N = 759)

H (path)	Path Description	β	*B*	95% CI		*SE*	*z*	*p*	S/ R
				Lower	Upper				
H1 (a)	Depression → Life Satisfaction (Figure 1A)	-.569	-1.904	-2.412	-1.396	.259	-7.348	.000	S
H1 (c)	Depression → Life Satisfaction (Figure 2A)	-.252	-.798	-1.240	-.162	-.355	-3.532	.000	S
H2 (d)	Positive Emotions → Resilience	.162	.136	.032	.240	.053	2.568	.010	S
H2 (b2)	Resilience → Life Satisfaction	.187	.318	.157	.480	.082	3.862	.000	S
H3 (b1)	Positive Emotions → Life Satisfaction	.306	.438	.276	.600	.083	5.292	.000	S
H4 (e)	Creativity → Depression	-.401	-.141	-.184	-.098	.022	-6.440	.000	S
H4 (f)	Income→ Depression	-.165	-.043	-.066	-.020	.012	-3.671	.000	S
H5 (g)	Children → Life Satisfaction	-.137	-.307	-.451	-.162	.074	-4.160	.000	R

**Note*. Estimator = MLR. H = Hypothesis, S = Hypothesis Supported, R = Hypothesis Rejected. *z* = z-value.

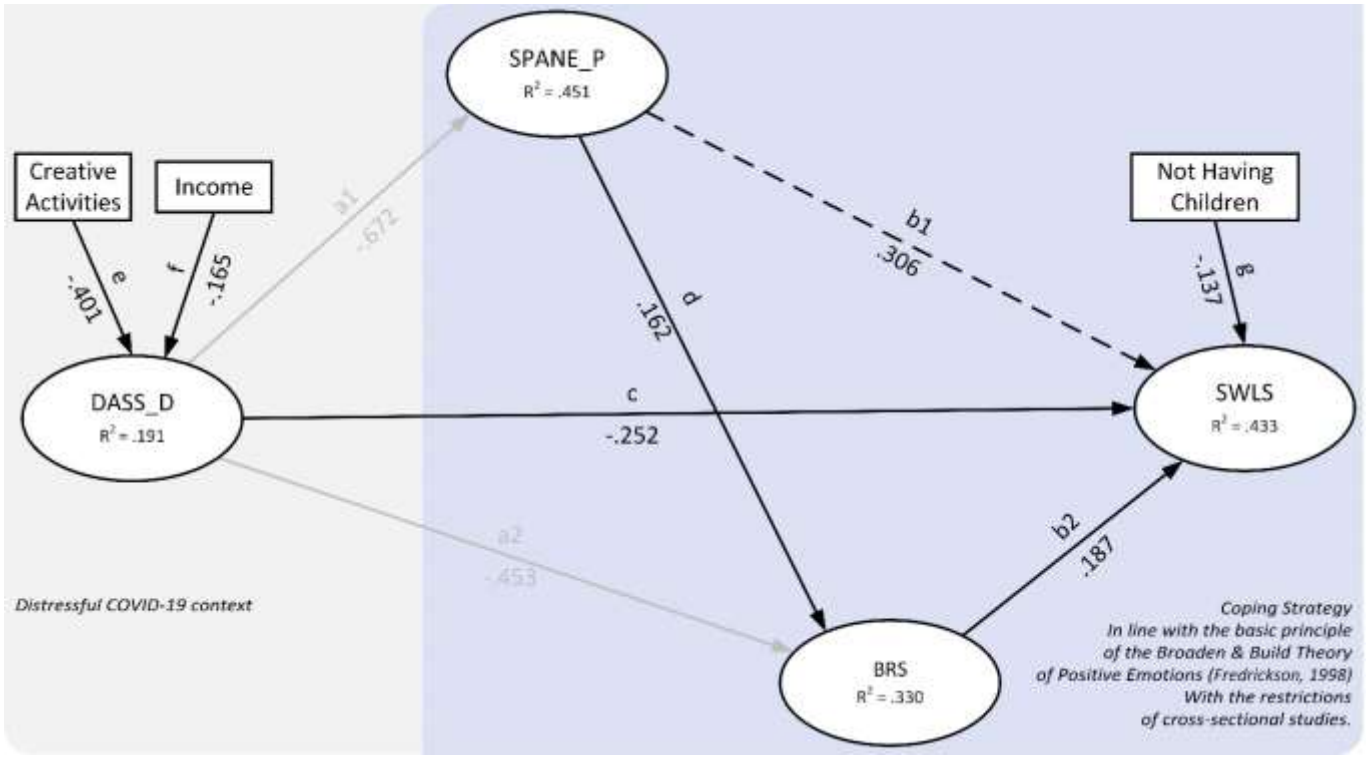

Figure 3. The path diagram of the structural model (standardized coefficients, all p <.001)

Table 6

Indirect and Total effects for Depression and Positive Emotions (in bold) on Life satisfaction (N = 759)

		95% CI				*p*	
Effect (path)	**Estimate**	**Lower**	**Upper**	***SE***	***z***	**(>|z|)**	***SD*** $_{ALL}$
Indirect 1 (a1 * b1)	-.650	-.926	-.373	.141	-4.604	.000	-.205
Indirect 2 (a2 * b2)	-.267	-.425	-.110	.080	-3.325	.001	-.085
Indirect 3 (a1 *d * b2)	-.064	-.128	.000	.033	-1.965	.049	-.020
TOTAL INDIRECT$_{DASS}$ (a1 * b1 + a2 * b2 + a1 * d * b2)	-.981	-1.344	-.618	.185	-5.295	.000	-.310
TOTAL$_{DASS}$ (a1 * b1 + a2 * b2 + a1 * d * b2 + c)	-1.779	-2.228	-1.329	.229	-7.759	.000	-.562
Indirect 4 (d * b2)	.043	.002	.084	.021	2.057	.040	.030
TOTAL$_{SPANE8_P}$ (d * b2 + b1)	.481	.318	.644	.083	5.780	.000	.336

**Note*. Estimator = MLR. *z* = z-value.

Discussion

The purpose of this study was to investigate whether positive emotions and resilience mediate the relationship between COVID-19 depression and life satisfaction (parallel and serial mediation), among a Greek sample of the general population, while controlling for the effect of perceived creative activities and income on depression and non-parenthood on life satisfaction. This could inform the rich literature on coping strategies against COVID-19 distressful context (e.g., Yang, 2021; Kar et al., 2021; Orgilés, et al., 2021). Initially we specified a SEM model (Figure 1A) to test the direct negative effect of COVID-19 depression on life satisfaction. Then (looking for coping strategies against COVID-19 distress), parallel and serial mediation was added, testing the mediation effect of positive emotions and resilience between COVID-19 depression and life satisfaction, while controlling for (a) engagement with creative activities on depression; (b) income on depression and (c) children on life satisfaction (Figure 2A).

Support of the Hypotheses

From the five hypotheses tested, four were verified and one was rejected. For the interpretation of the structural results, we adopted Kline's (2011) criteria, proposing that a standardized direct effect of about 0.10 is small, of about 0.30 medium, and of about 0.50 large.

Interpretation of Results

The initial SEM model to test the direct negative effect of depression on life satisfaction showed a good fit. The direct standardized path suggested that depression had a significant, direct, very large negative effect on life satisfaction of the early quarantined individuals (H1, path a, standardized path value = -.57), with 32% explained variance. Subsequently, three additional paths were specified between depression and life satisfaction H2-H3). Crucially, when these paths were added, the large direct negative effect of depression on life satisfaction became low to moderate (H1, path c; standardized path value = -.25) with more than 43% explained variance.

Elaborating more on the statistical validity of this second model with parallel and serial mediation effects, the fit of the measurement model was very good. Considering, model fit, factor loadings, factor intercorrelations, and explained variances, the reliability of the measurement model was adequate (Kyriazos, 2017c). Moreover, CR (ω_t coefficient; McDonald, 1999) was acceptable with one exception and AVE ranged from marginally acceptable to satisfactory (Kyriazos, 2017d). Model-based convergent and discriminant validity of the measurement model was also verified and cross-validated successfully. Finally, measurement invariance of the measurement model was established successfully to the strict level. That is, measurement differences can be safely evaluated across

male and female respondents, because the factor structure, factor loadings, intercepts, and error variances of the measurement model were invariant across gender.

Focusing on interpreting the direct standardized structural paths on this second model with parallel and serial mediation effects, they suggested that depression had now a significant, direct negative effect of a low to moderate magnitude on life satisfaction of the early quarantined individuals (H1, path c; standardized path value dropped to -.25 from -.57), through a positive and significant effect on positive emotions and resilience (more than 43% explained variance on life satisfaction). More specifically on the each of direct effects, positive emotions had a positive and significant low to moderate effect on resilience that in turn had a positive and significant low to moderate effect on life satisfaction (with parallel and serial mediation). Moreover, this moderate positive and significant effect of positive emotions on life-satisfaction had also a positive and significant effect on life satisfaction directly, at a moderate magnitude.

All the direct standardized paths were tested when controlling for the effect of creativity on depression, income on depression, and non-parenthood on life satisfaction during the early COVID-19 containment measures. Increased engagement with creative activities had a significant, direct negative, moderately high effect on depression. At the same time increased income had a significant, direct negative, low effect on depression. However, not having children when in early COVID-19 quarantine also had a significant, direct negative, low effect on life satisfaction. The fit of the second model with parallel and serial mediation effects was equally good. The structural paths suggested that positive emotions and resilience mediated between depression and life satisfaction. In other words, positive emotions had a positive and significant effect on life satisfaction through resilience building (i.e. through a positive and significant effect on resilience).

Similarity of Results

The significant negative effect of positive emotions, resilience, and life satisfaction on depression are well documented in literature (Cohn et al., 2009; Fredrickson et al., 2003; Fredrickson et al., 2008). Experiments showed that positive emotions mediated in achieving faster cardiovascular recovery from negative emotional arousal (Tugade & Fredrickson, 2004). This suggests that positive emotions can mitigate the negative effects of distress in high-resilient individuals (Fredrickson, 2002; Fredrickson, 2000). Prospective studies reported that positive emotions can initiate coping strategies when in adversity such as bereavement, illness, or national disaster (Bonanno et al., 2001; Bonanno et al., 2015; Fredrickson et al., 2003). That is, increases in positive emotions were related to significant increase in resilience and other resources, which are sequentially related to significantly higher life satisfaction and lower depression (Cohn et al., 2009; Fredrickson et al., 2008). Moreover, high-resilient individuals reported lower levels of depression, and more self-reported optimism, life satisfaction, and tranquility in the aftershock of the September 11 attacks (Fredrickson et al., 2003).

Additionally, drawing on evidence from the broaden and build theory of positive emotions (Fredrickson 2008, 2001), only positive emotions were reported to predict an increase in life satisfaction (Cohn et al., 2009; Fredrickson et al., 2008). This finding was not verified in this study, because positive emotions both indirectly (through resilience) and directly predicted a significant increase in life satisfaction. However, the results are not directly comparable as this is a cross-sectional study and it is not possible to track the conceptual distinction between transient positive emotions experience and global life quality judgments (Fredrickson et al., 2008) found in prospective studies (Cohn et al., 2009; Fredrickson et al., 2008).

Regarding, the hypotheses (H4-5) controlling for the effects of perceived engagement with creative activities on depression, income on depression, and non-parenthood on life satisfaction during the early COVID-19 quarantine, the significant positive effect of engagement with perceived creative activities on depression during the early COVID-19 quarantine (H4), recent studies on the impact of early COVID-19 on subjective well-being, using machine learning (Kyriazos et al., 2021a) argued that through engagement with creative activities during the quarantine, individuals had high probabilities to be among the top 25% well-being scorers. Regarding the

significant positive effect of income on depression during the early COVID-19 quarantine (H4), the same machine learning study (Kyriazos et al., 2021a), proposed that only when the perceived financial impact of the quarantine was mild the quarantined individuals had high probabilities to be among the top 25% well-being scorers. Finally, regarding the positive effect of not having children on life satisfaction during quarantine, while high concerns about the infection of children were significantly associated with higher stress, post-traumatic stress, and anxiety in Asian cultures (China, Wang et al., 2020), not having children was significantly associated with lesser depression in western cultures (Italy, Mazza et al., 2020). Thus, the early COVID-19 literature reports controversial findings on the effects of parenthood; maybe because parenthood is a construct highly related to the cultural context (Elgar et al., 2007).

Generalizability, Implications, limitations

The generalizability of the findings is relatively safe to make due to their statistical validity, i.e. the good fit of the SEM model, robust loadings, highly significant effects and power analysis indicated more than enough sample size.

Interpretation of the findings however should be made cautiously because of the sampling method, and the cross-sectional design of the study. This cross-sectional design cannot allow causal inferences (Kline, 2020) because causality is only a matter of design (Ullman, 2013), and only experimental designs can support causal inferences (Shadish, Cook & Campbell 2001; Stalikas & Kyriazos, 2019). Crucially, this study did not have the intention to test the tenability of the broaden-and-build theory (Fredrickson, 1998, 2001) or any other theory with a cross-sectional design. Only to use this well documented theory to support the existing structural paths (see Arslan, 2021; Chang, et al., 2019; Trigueros et al. 2019 for similar cross-sectional approaches). Therefore, this is a cross-sectional study design, due to the inherent limitations of conducting research during COVID-19 quarantine and the parallel and serial mediation model does not imply causality.

One of the study limitations was the imbalanced sample in terms of gender. Additionally, some COVID-related demographics were underrepresented due to the low COVID-19 exposure of the general population during the early COVID-19 quarantine. Another limitation was that the study took place right after the very start of the quarantine period in Greece, so the initial response to the quarantine (if any) could be unrecorded. However, this would require a longitudinal design with more than one wave. The study was also limited by its reliance on a monocultural sample, a unique data collection method, and self-report measures of health-related behaviors, and well-being (see Pavot, 2018 for concerns on well-being measurement).

Future research may be oriented on the way positive emotions could increase coping resources like life meaning (for Greece see Stalikas, Kyriazos, Yotsidi & Prassa, 2018; Kyriazos, Galanakis, Katerelos & Stalikas, 2021) mediate between depression and other well-being indicators, e.g. flourishing (for Greece see Kyriazos, Stalikas, Prassa, Yotsidi, Galanakis, & Pezirkianidis, 2018). Moreover, research on LS during COVID-19 could focus more on contexts where conflicting results emerge, e.g. parenting (for Greece see Kyriazos & Stalikas, 2018; Kyriazos & Stalikas, 2019a; Kyriazos & Stalikas, 2019b) or interpersonal relationships (for Greece see Giotsa, Kyriazos & Mitrogiorgou, 2018). Regarding techniques employed, except SEM other multivariate approaches could be appropriate to model the complex interaction between psychological distress and COVID-19 comorbidities (Holmes et al., 2020) like CFA Multitrait-Multimethod Matrices (see Brown, 2015; Kyriazos, 2018) or Multilevel Modeling (see Brown, 2015; Kyriazos, 2019).

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Appendix

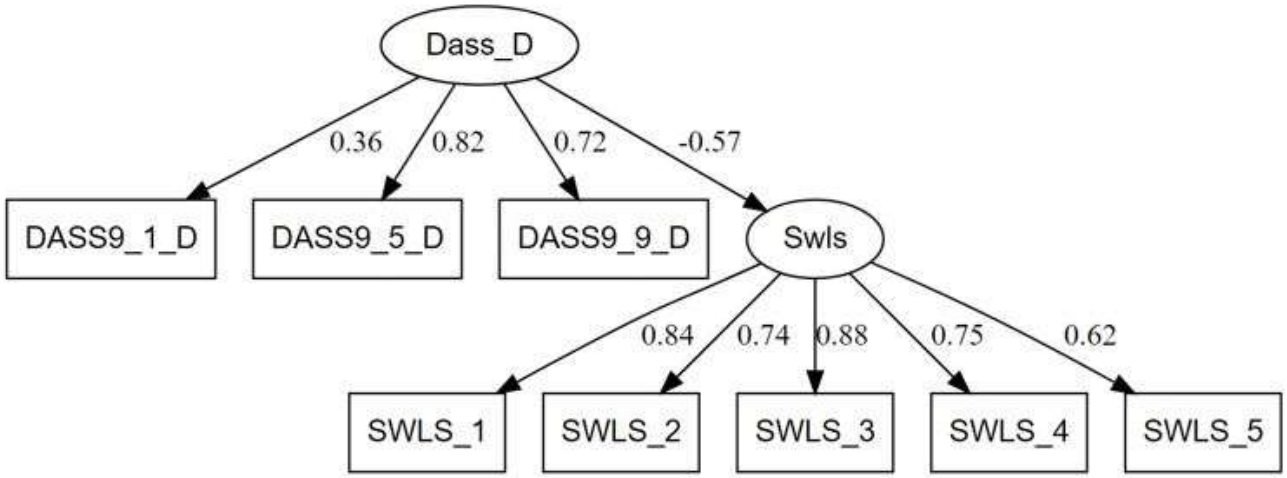

Figure 1A. The path diagram of the full SEM model modeling the relationships between COVID-19 Depression (DASS-D) and life sati satisfaction (SWLS) tested without the mediation effects of positive emotions and resilience.

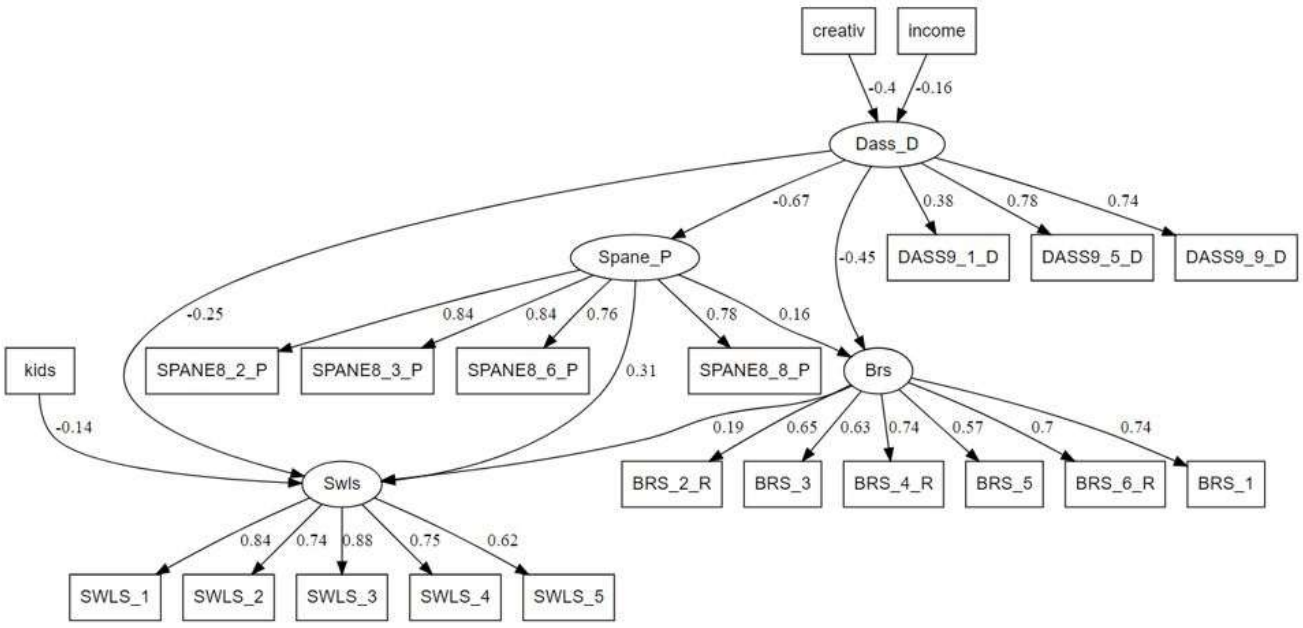

Figure 2A. The path diagram of the full SEM model, modeling the relationships between COVID-19 Depression (DASS-D), and Life Satisfaction (SWLS) after adding the serial and parallel mediation of positive emotions (SPANE-P), Resilience (BRS) while controlling for engagement with creative activities, income and children

ΕΜΠΕΙΡΙΚΗ ΕΡΓΑΣΙΑ | RESEARCH PAPER

Η προστατευτική επίδραση των Θετικών Συναισθημάτων κατά της Κατάθλιψης στη διάρκεια της αρχικής καραντίνας για τον COVID-19, σε ένα Μοντέλο Δομικών Εξισώσεων (SEM)

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ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ

ανθεκτικότητα,
COVID-19,
θετικά συναισθήματα,
Θεωρία Broaden and Build,
ικανοποίηση από τη ζωή,
κατάθλιψη,
μοντέλα δομικών εξισώσεων

ΣΤΟΙΧΕΙΑ ΕΠΙΚΟΙΝΩΝΙΑΣ

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ΠΕΡΙΛΗΨΗ

Ο σκοπός της παρούσας μελέτης ήταν να ελεγχθεί αν τα θετικά συναισθήματα και η ανθεκτικότητα διαμεσολαβούν τη σχέση μεταξύ της κατάθλιψης εξαιτίας του COVID-19 και της ικανοποίησης από τη ζωή. Επιπλέον διερευνήθηκε η άμεση επίδραση των θετικών συναισθημάτων και του εισοδήματος στην κατάθλιψη, καθώς και η επίδραση της απουσίας γονεϊκού ρόλου στην ικανοποίηση από τη ζωή. Η μελέτη πραγματοποιήθηκε κατά τη διάρκεια της αρχικής καραντίνας για τον COVID-19, σε ελληνικό δείγμα γενικού πληθυσμού (N = 759). Για το σκοπό αυτό, χρησιμοποιήθηκαν οι ακόλουθες ψυχομετρικές κλίμακες: Depression, Anxiety and Stress Scale, Short (DASS 9), Scale of Positive and Negative Experience short (SPANE 8), Satisfaction with Life Scale (SWLS) και Brief Resilience Scale (BRS). Για την ανάλυση των δεδομένων δημιουργήθηκε ένα Μοντέλο Δομικών Εξισώσεων (SEM). Το μετρικό μοντέλο έδειξε καλή προσαρμογή με επαρκή αξιοπιστία βάσει μοντέλου. Επιπλέον επιτεύχθηκε η πλήρης αμεταβλησία μέτρησης ως προς το φύλο ως το αυστηρό επίπεδο. Παράλληλα, το πλήρες μοντέλο SEM (μετρικό και δομικό) έδειξε εξίσου καλή προσαρμογή. Οι πέντε από τις ελεγχθείσες υποθέσεις υποστηρίζονταν, ενώ η μία απορρίφθηκε. Η παρούσα κατέληξε στο ότι τα θετικά συναισθήματα και η ανθεκτικότητα διαμεσολαβούσαν στη σχέση της κατάθλιψης και της ικανοποίησης από τη ζωή. Η επίδραση της κατάθλιψης εν μέσω COVID-19 στην ικανοποίηση από τη ζωή πριν την διαμεσολάβηση ήταν -0.57, $p < 0.001$ (εξηγώντας 32% της διακύμανσης στην ικανοποίηση από τη ζωή). Έπειτα από τη διαμεσολάβηση των θετικών συναισθημάτων και της ανθεκτικότητας, περιορίστηκε στο -0.25, $p < 0.001$ (εξηγώντας 43% της διακύμανσης στην ικανοποίηση από τη ζωή).

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