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Articles

Latent Changes in Perceived Quality of Sleep Related to the COVID-19 Quarantine Measures in Italian University Students: Understanding the Role of Personality and Internalizing Symptoms

Antonella Somma [1], Sara Marelli [1,2], Giulia Gialdi [1], Alessandra Castelnuovo [2], Samantha Mombelli [2], Luigi Ferini-Strambi [1, 2], Andrea Fossati [1]

Abstract

The present online retrospective study aimed at evaluating the perceived sleep quality before the start of the lockdown measures and during the lockdown in a sample of Italian university students (N = 307). Participants were administered the Italian translation of the Pittsburg Sleep Quality Index (PSQI), the Beck Depression Inventory (BDI), the Beck Anxiety Inventory (BAI), and the Personality Inventory for *DSM-5* 36-item version (PID-5-36) in order to assess the relationships between sleep, dysfunctional personality domains and internalizing symptomatology. Latent difference factor (LDF) model was used to estimate latent change in PSQI scores; all analyses on the relationships between the PSQI and the dysfunctional personality domain measures and internalizing symptoms were carried out using latent factor scores. Our findings showed that selected dysfunctional personality traits were significantly associated with changes in perceived quality of sleep among adult university students during the lockdown in Italy. The relationship between PID-5-36 Negative Affectivity and changes in the perceived quality of sleep was only partially mediated by the severity of self-reported depression. The assessment of perceived depressive symptom severity and Negative Affectivity may prove clinically useful for carrying out preventive interventions on sleep quality.

[1] School of Psychology, Vita-Salute San Raffaele University, Milan, Italy

[2] Neurology – Sleep Disorder Center, IRCCS San Raffaele Scientific Institute, Milan, Italy

E-mail corresponding author: fossati.andrea@hsr.it

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1. Introduction

First diagnosed in Wuhan City, China in December 2019, coronavirus disease (COVID-19) has been first declared a public health emergency of international concern, and soon thereafter a pandemic by the World Health Organization (WHO). Different from individual level traumatic events, the COVID-19 pandemic has been a continuing crisis for every member of society (Tang et al., 2020), and governments have had to implement extraordinary social distancing interventions to slow the spread of the virus. Many European countries, including Italy, have imposed major restrictions on meetings, travel, and everyday life. These measures were necessary to slow down the viral transmission chains (Remuzzi & Remuzzi, 2020), and met the standards for mass quarantine (e.g., Brooks et al., 2020).

Prolonged home confinement during a disease outbreak may affect people's physical and mental health (Brooks et al., 2020; Settineri & Merlo, 2020a, b; Wang et al., 2020; WHO, 2020). Moreover, lockdown changed daily habits, including social interactions, the ability to perform sports, diet (Di Giacomo, 2020; Scarmozzino & Visioli, 2020), and sleep (Li et al., 2020). Recent research findings showed that medical staff from several Chinese provinces who treated patients with COVID-19 infection in January and February 2020 had poor sleep quality (Xiao et al., 2020). Similar results were found in a cross-sectional study involving a sample of 1,310 young adults (age range: 18-35 years) living in Italy (Cellini et al., 2020). Participants reported increased usage of digital media near bedtime and a lower sleep quality, with increased sleep difficulties for people with a higher level of depression and anxiety (Cellini et al., 2020).

Academic health systems are essential to support their communities during the COVID-19 outbreak (Kim et al., 2020). University students are known to be prone to elevated levels of stress due to intense academic requests, pressure to independence, and financial difficulties (Veeramachaneni et al., 2019). Anxiety and stress caused by rising epidemic data, the helplessness and fear caused by city closure and isolation, and the boredom and irritability caused by university closures have a strong impact on college student's mental health (Tang et al., 2020). Tang and colleagues' (2020) carried out a study aiming at identifying the psychological distress risk factors in a sample of 2,485 home-quarantined Chines students from six universities and showed that feeling extreme fear was the most significant risk factor for psychological distress, followed by short sleep duration (Tang et al., 2020). Indeed, shorter sleep duration was found to be significantly associated with mental health consequences, suggesting the need for psychological interventions for university students aiming at improving sleep duration and

quality (Tan et al., 2020). Similar findings were observed in a sample of 1,000 university students in Greece, where 43.0% of participants reported worse sleep quality (Kaparounaki et al., 2020).

Personality traits are known to play a role in explaining factors behind sleep problems (e.g., van de Laar et al., 2010). Previous studies examining the relationships between five factor personality traits and sleep showed that higher levels of neuroticism were associated with sleep problems (e.g., Hintsanen et al., 2014). Interestingly, both in the *International Statistical Classification of Diseases and Related Health Problems*, 11th revision (*ICD-11*) and the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (*DSM-5;* APA, 2013) Alternative Model of Personality Disorders (AMPD), relied on maladaptive personality domains to describe the individual expression of personality disturbance. Both *ICD-11* and *DSM-5* AMPD describe trait domains of negative affectivity, detachment, antagonism/dissociality, and disinhibition. Previous studies (e.g., Oltmanns & Widiger, 2018; Somma et al., 2020) showed that four of the five *ICD-11* domains are closely aligned with four of the five *DSM–5* Section III domains (Mulder et al., 2016); more specifically, *ICD-11* negative affective, detachment, dissocial, and disinhibition align with *DSM–5* AMPD negative affectivity (i.e., frequent and intense experiences of high levels of a wide range of negative emotions), detachment (i.e., avoidance of socioemotional experience), antagonism (i.e., behaviors that put the individual at odds with other people), and disinhibition (i.e., orientation toward immediate gratification), respectively. In addition, the *DSM-5* AMPD also includes a separate domain of psychoticism (i.e., exhibiting a wide range of culturally incongruent odd, eccentric, or unusual behaviors and cognitions), whereas the *ICD-11* includes a separate domain of anankastia (i.e., a narrow focus on one's rigid standard of perfection and of right and wrong, and on controlling one's own and others' behavior and controlling situations to ensure conformity to these standards) (e.g., Bach et al., 2020; Krueger & Markon, 2014).

Recent data on the associations between psychological distress and maladaptive personality domains showed that negative affectivity (i.e., the maladaptive variants of neuroticism; Suzuki et al., 2015) and detachment (i.e., the dysfunctional variants of extraversion; Suzuki et al., 2015) were associated with higher levels of depression and anxiety (Mazza et al., 2020), and represented relevant risk factors for reduced emotional well-being (Somma et al., 2020) during the first phase of the COVID-19 pandemic in Italy. Although there has been a growing research literature on maladaptive personality traits and sleep (see, for a review, Oltmanns, 2019), to the best of our knowledge, no study tried to evaluate the associations between the maladaptive personality domains listed in *ICD-11/DSM-5* AMPD, depression and anxiety and sleep problems during the COVID-19 pandemic. Studies on the prevalence and risk factors for potential sleep problems among university students could assist counselors and clinicians to

prevent, target or deal with the possible negative consequences of COVID-19 epidemics on general college student populations (see also, Tang et al., 2020). Indeed, examining the role of maladaptive personality domains on sleep disturbances during the COVID-19 pandemic may increase our understanding of risk factors for sleep problems, providing useful insights for managing COVID-19 sleep disruption (e.g., Altena et al., 2020).

Against this background, we designed the present study aiming at evaluating the perceived sleep quality before the start of the lockdown measures in Italy (i.e., before March 9th, 2020), and during the lockdown (i.e., from March 9th, 2020 to May, 3rd, 2020) in a sample of Italian university students who agreed to take part in an online retrospective study on sleep, dysfunctional personality domains and anxiety, and depression symptomatology. Because observed score differences are known to represent poorly reliable measures of change, in the present study we relied on the latent difference approach to measuring change (Finch & Shim, 2018). It should be observed that poorly reliable measures are plagued by random measurement error; in turn, it may result in poor measure dependability, in clinical practice, and in menace to replicability of findings in research (Nunnally & Bernstein, 1994). To overcome the difficulties of using well-behaved models of latent change (i.e., latent growth curves) in situations where only two measurement occasions are available (as it is frequent in medical research), recently Finch and Shim (2018) proposed the latent difference factor (LDF) model as a viable alternative.

The LDF method is based on four steps (Finch & Shim, 2018); in step 1, the goodness-of-fit of the one-factor model of the observable indicators at measurement occasion 1 should be assessed using a confirmatory factor analysis (CFA); then, in step 2 the same procedure should be applied to measurement occasion 2 observable indicators; in step 3, the difference between the observable indicators scores in the two measurement occasions should be computed; finally, in step 4 the one-factor model goodness-of-fit of the difference scores of the observable indicators should be assessed using CFA. Finch and Shim (2018) provided evidence for the accuracy of their method using both simulation and real data. One of the main advantages of the LDF method is that it allows to consider the relationship between the LDF with predictors and or moderators within a structural equation modelling (SEM) framework.

In line with previous studies (e.g., Cellini et al., 2020) participants were administered the Italian translation of the Pittsburg Sleep Quality Index (PSQI; Curcio et al., 2013) and were asked to report their sleep quality before the beginning of the lockdown and after the introduction of lockdown measures. Based on previous findings (Cellini et al., 2020), significant increase of the PSQI score under the restriction were hypothesized. Because previous studies (e.g., Brooks et

al., 2020) reported depression and anxiety as the most frequent symptomatology during the COVID-19 quarantine, we assessed these symptoms relying on the Italian translations of the Beck Depression Inventory (Beck et al., 1996) and Beck Anxiety Inventory (BAI; Beck et al., 1961); moreover, participants were administered the 36-item version of the Personality Inventory for *DSM-5* (PID-5-36; Bach et al., 2020). The PID-5-36 represents a well validated (Bach et al., 2020), reasonably short measure, covering both the dysfunctional personality domains listed in the Alternative Model of Personality Disorders (AMPD) of the *DSM-5* (APA, 2013a) and in the International Classification of Disease – 11th edition (*ICD-11*; World Health Organization, 2019) maladaptive personality domains.

Since we relied on LDF approach to assess sleep quality change, we examined the associations between latent change in sleep quality, depression, anxiety, and maladaptive personality domains using multiple indicators multiple causes models (MIMIC; Muthén, 1989). Based on previous data, we expected latent change in sleep quality to be associated with depression and anxiety symptoms (e.g., Wang et al., 2020), as well as with PID-5-36 Negative affectivity domain (Mazza et al., 2020; Somma et al., 2020).

Finally, we tested a SEM mediation model in order to evaluate the role of depression and anxiety symptoms in explain the relationship between Negative Affectivity and latent change in sleep quality. Indeed, previous studies showed that neuroticism was significantly associated with higher levels of depression and anxiety (e.g., Cuijpers et al., 2010), as well as sleep disturbances (e.g., Hintsanen et al., 2014). Examining the possible mediation role of depression and anxiety in explaining the relationships between Negative affectivity (i.e., high neuroticism) and the change over time in sleep quality from the beginning of the COVID-19 lockdown to the introduction of lockdown measures may provide useful information in order to provide college students with tailored psychological interventions focused on specific risk factors for developing sleep disturbances during the COVID-19 pandemic.

2. Methods

2.1 Participants

The sample was composed of 307 adult university students who responded to advertisements that were published on the website of the Vita-Salute San Raffaele University of Milan, Italy, during March 2020. Seventy-seven (25.1%) participants were male and 230 (74.9%) were female; participants' mean age was 22.84 years, SD = 2.69 years (age range: 18-34 years). A total of 54 (17.6%) participants reported incomplete data on the sleep quality and/or dysfunctional

personality self-report questionnaires; according to Little MCAR test missing values were completely at random, $\chi^2(34) = 33.88, p = .47$. Thus, missing responses could be safely estimated using the expectation-maximization algorithm.

2.2 Procedures

Participants had to sign a written informed consent form that included a detailed description of the study. The study obtained the approval from the Ethical Committee of the Vita Salute-San Raffaele University/San Raffaele Hospital of Milan, Italy. Participants were asked to report the quality of their sleep before the lockdown measures for preventing the COVID-19 pandemic in Italy and during the COVID-19 related lockdown, while being also asked to complete measures of depression and anxiety symptoms, and dysfunctional personality domains. Participants were administered online the official Italian translations of the sleep quality, depression, anxiety, and dysfunctional personality domain measures; all self-report questionnaires were anonymously completed and automatically scored.

2.3 Measures

2.3.1 The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI is a self-report questionnaire that assesses sleep quality over a 1-month time interval. The measure consists of 19 individual items, creating 7 components that produce one global score, and takes 5–10 minutes to complete; the higher the PSQI total score the poorer the perceived sleep quality (Buysse et al., 1989). Clinical studies have found the PSQI to be reliable and valid in the assessment of sleep problems to some degree, but more so with self-reported sleep problems and depression-related symptoms than actigraphic measures (e.g., Grandner et al., 2006). The PSQI was translated into Italian (Curcio et al., 2013); Curcio and colleagues (2013) provided data on the validity of the Italian translation of the PSQI. In the present study, the respondent's instructions of the PSQI were modified, and participants were asked to complete two PSQI forms, which differed exclusively for their respondent's instructions. In one version, participants were instructed to respond to the PSQI items based on their perceived sleep quality before the COVID-19 related lockdown. In the other version, participants were asked to respond to the PSQI items reporting their perceived sleep quality during the COVID-19 related lockdown.

2.3.2 Beck Depression Inventory (BDI-II; Beck et al., 1996). The BDI-II is a 21-item Likert-type self-report questionnaire, for measuring the perceived severity of depression (Beck et al., 1996). The BDI-II is composed of items measuring symptoms of depression such as

hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms. Each BDI-II item is scored on a four-point Likert scale ranging from 0 (*not at all*) to 3 (*severely*); the higher the BDI-II total score, the higher the severity of perceived depression symptoms. The BDI-II was translated into Italian (Sica & Ghisi, 2007); Sica and Ghisi (2007) provided extensive data on the psychometric properties of the Italian translation of the BDI-II.

2.3.3 Beck Anxiety Inventory (BAI; Beck et al., 1988). The BAI is a 21-item Likert-type self-report questionnaire that was designed to assess the severity of anxiety in subjects who are of 17 years of age or older (Beck et al., 1988). BAI items measure common symptoms of anxiety that the subject has had during the past week, such as numbness and tingling, sweating not due to heat, and fear of the worst happening. Each BAI item is scored on a four-point Likert scale ranging from *0* (*not at all*) to *3* (*severely*); the higher the BAI total score, the higher the severity of perceived anxiety symptoms. The BAI takes 5 to 10 minutes to complete. Several studies have found the BAI to be an accurate measure of anxiety symptoms in adults (e.g., Leyfer et al., 2006). The BAI has been translated into Italian (Sica & Ghisi, 2007); Sica and Ghisi (2007) provided extensive data on the psychometric properties of the Italian translation of the BAI.

2.3.4 Personality Inventory for *DSM-5* 36-Item Form (PID-5-36; Bach et al., 2020; Kerber et al., 2020). The PID-5-36 is a 36-item self-report instrument developed by Bach and colleagues (2020) to assess the combined *DSM-5* and *ICD-11* domains (i.e., negative affectivity, detachment, antagonism, disinhibition, anankastia, and psychoticism). Each PID-5-36 item is rated on a four-point Likert scale ranging from 0 (*Very false or often false*) to 3 (*Very true or often true*). The PID-5-36 provides six items for each domain scale; the higher the total score for a given PID-5-36 domain scale, the higher the intensity of the corresponding dysfunctional personality domain. The PID-5-BF-36 psychometric properties have been tested in an international collaborative study, which includes the Italian translation of the PID-5-BF-36 (Bach et al., 2020). The PID-5-36 showed to be provided with adequate factor validity; moreover, the six PID-5-BF-36 domain scales were provided with good discriminant validity and meaningful continuity with interview-rated PD across 13 languages, including Italian (Bach et al., 2020).

2.4 Data analysis

For all psychometric measure composite scores, the internal consistency reliability was estimated using Cronbach's alpha coefficient. Bonferroni paired-sample *t*-tests were computed to carry out mean comparisons between the PSQI scores that reflected pre-lockdown perceived quality

of sleep and the perceived quality of sleep during lockdown; Pearson *r* coefficient was used to estimate the rank-order consistency of the two sets of PSQI scores. For both paired-sample *t*-tests and *r* coefficients the nominal significance level (i.e., $p < .05$) was corrected according to the Bonferroni procedure and set at $p < .00625$.

Considering the well-known problems with using observed score difference to assess change, in the present study we relied on latent difference factor model of the PSQI to estimate the latent change in sleep quality from pre-lockdown scores to those obtained during the lockdown. Following Finch and Shim (2018), we first tested the goodness-of-fit of the one-factor model of the PSQI components by carrying out separate robust maximum likelihood (MLR) confirmatory factor analyses (CFAs) of the Pearson *r* correlation matrices based on the PSQI pre-lockdown scores and lockdown scores, respectively. Model fit was evaluated using the MLR χ^2 test, the root mean square error of approximation (RMSEA) and the related 90% confidence interval, the comparative (CFI) and Tucker-Lewis (TLI) fit indices, and the standardized root mean square residual (SRMSR). Consistent with Hu and Bentler' (1999) indications, we used the following cut-off values to evaluate the model fit: a TLI/CFI of .90 and higher, and an RMSEA of .08 and lower are indications of an adequate fit, while a TLI/CFI of .95 and higher and an RMSEA of .05 and lower are indications of a good fit. It has been suggested that a SRMR lower than .08 indicates good fit (Hu & Bentler, 1999).

If acceptable fit statistic values were obtained for the one-factor model of the PSQI pre-lockdown component scores and lockdown component scores, respectively, then difference scores (i.e., PSQI component score during the lockdown – PSQI pre-lockdown component score) were computed for the observable PSQI components; consistent with Finch and Shim's (2018) indications, these differences scores were used as observable indicators for testing a unidimensional (i.e., one-factor) latent difference factor model. The goodness-of-fit of the latent difference factor model was assessed using the same statistics and criteria that were described above. In the present study, the PSQI measures were used in further structural equation models (SEMs).

In the SEM framework, how well the latent variable is represented by a particular set of items represents a crucial issue (Rodriguez et al., 2016). To address this issue, Hankock and Mueller (2001) proposed the construct reliability/replicability *H* coefficient. *H* coefficient is thought to estimate the correlation between a factor and an optimally weighted item composite. Thus, *H* index is more appropriate for evaluating the feasibility of specifying a measurement model in an SEM framework using a particular set of items than conventional internal consistency reliability

indices (Rodriguez et al., 2016). *H* index values ≥.70 should be obtained for using a set of measures in SEM framework (Hankock & Mueller, 2001; Rodriguez et al., 2016).

The bivariate associations between the PID-5-36 domain scale scores, BDI total scores, and BAI total scores were assessed by computing Pearson *r* coefficients. Because the BDI and BAI total scores were significantly correlated, multivariate multiple regression was used to evaluate the significance of the PID-5-36 domain scale scores as predictors of the BDI and BAI total scores, respectively. Standardized regression (i.e., β) coefficients were computed to evaluate the unique contribution of the individual PID-5-36 domain scale scores. The nominal significance level (i.e. $p < .05$) for β coefficients was corrected according to the Bonferroni procedure for the overall number of coefficients that was estimated in the simultaneous equations and set at $p < .004$. R^2 and adjusted R^2 coefficients were used to evaluate the overall amount explained in each dependent variable by the predictor set.

In order to evaluate the role of dysfunctional personality domains, depression and anxiety symptoms as predictors of the pre-lockdown PSQI component latent factor, lockdown PSQI component latent factor, and PSQI latent different factors, respectively, the five PID-5-36 domain scale scores, and the BDI and BAI total scores were entered as observable covariates (i.e., independent variables) in the corresponding SEM (i.e., we relied on multiple indicators, multiple causes model [MIMIC]; Muthén, 1989). The limited size of our sample prevented us from entering the PID-5-36 items, as well as the BDI and BAI items, as indicators of the corresponding latent factors in the context of the SEM framework. Within each multiple regression equation, the nominal significance level of the standardized regression coefficients was corrected according to the Bonferroni procedure and set at $p < .0083$ and $p < .025$ for the PID-5 domain scales, and BDI and BAI, respectively.

In the case MIMIC analyses showed that both measures of personality dysfunction and internalizing symptoms significantly predicted the PSQI latent difference factor, a mediation model was tested in the context of the SEM framework to evaluate if the BDI/BAI scores were significant mediator of the relationship between selected PID-5-36 domain scale scores and the PSQI latent difference factor. The significance of the standardized indirect effect was tested using bias-corrected bootstrap 95% confidence interval based on 10,000 independent bootstrap samples. All models were estimated using *M*plus 8.4 (Muthén & Muthén, 2012-2019).

3. Results

The descriptive statistics, mean comparisons, and Pearson *r* values of the PSQI pre-lockdown and during COVID-19 lockdown scores in our sample are listed in Table 1.

Table 1. Pittsburgh Sleep Quality Index Pre-Lockdown and During COVID-19 Lockdown Scores in Italian University Students: Descriptive Statistics, Mean Comparisons, and Pearson r Values (N = 307)

	Pre-Lockdown Scores		Lockdown Scores				
Pittsburgh Sleep Quality Index Scores	*M*	*SD*	*M*	*SD*	*t*(306)	*d*	*r*
Subjective Sleep Quality	1.07	0.70	1.54	0.88	-8.46*	-0.48	0.24
Sleep Latency	1.31	0.87	1.49	1.01	-2.99*	-0.17	0.43
Sleep Duration	0.57	0.72	0.55	0.80	0.33	0.02	0.35
Sleep Efficiency	0.27	0.60	0.43	0.73	-3.35*	-0.19	0.23
Sleep Disturbance	1.07	0.43	1.14	0.45	-2.76*	-0.16	0.42
Use of Sleep Medication	0.25	0.69	0.29	0.81	-1.21	-0.07	0.68
Daytime Dysfunction	0.89	0.61	1.24	0.70	-7.73*	-0.44	0.25
Total Score	5.42	2.78	6.69	3.26	-7.16*	-0.41	0.49

Note. d: Cohen's *d* effect size measure; the nominal significance level (i.e., $p < .05$) was corrected according to the Bonferroni procedure and set at $p < .00625$.

* $p < .00625$

The Cronbach's alpha values were .69 (mean inter-item $r = .24$) and .69 (mean inter-item $r = .25$) for the PSQI pre-lockdown total scores and during lockdown total scores, respectively.

In order to fit the latent difference factor model of the PSQI component, we first tested the goodness-of-fit of the one-factor model of the PSQI components in MLR CFAs of the pre-lockdown and lockdown score correlation (i.e., Pearson *r*) matrices. In the case of acceptable fit, the unidimensional model of the difference scores of the PSQI components was formally assessed using the MLR CFA. The standardized factor loadings, goodness-of-fit statistics, factor scale reliabilities (i.e., omega coefficient values), and construct reliabilities (i.e., *H* coefficient values) based on the MLR CFAs for the latent difference factor model are summarized in Table 2.

Table 2. Pittsburgh Sleep Quality Index Latent Difference Factor Confirmatory Factor Analysis Results: Standardized Factor Loadings, Goodness-of-Fit Statistics, Factor Scale Reliabilities (i.e., Omega Coefficient Values), and Construct Reliabilities (i.e., H Coefficient Values) in Italian University Students (N = 307).

	Pre-Lockdown	Lockdown		LDF
Pittsburgh Sleep Quality Index Components	λ	λ	Pittsburgh Sleep Quality Index Component Difference Scores	λ
Subjective Sleep Quality	.65***	.75***	Δ-Subjective Sleep Quality	.46***
Sleep Latency	.66***	.53***	Δ-Sleep Latency	.79***
Sleep Duration	.48***	.47***	Δ-Sleep Duration	.58***
Sleep Efficiency	.53***	.36***	Δ-Sleep Efficiency	.24**
Sleep Disturbance	.42***	.47***	Δ-Sleep Disturbance	.25**
Use of Sleep Medication	.41***	.30***	Δ-Use of Sleep Medication	.22**
Daytime Dysfunction	.32***	.53***	Δ-Daytime Dysfunction	.32***
One-Factor Models Goodness-of-Fit Statistics			**One-Factor Models Goodness-of-Fit Statistics**	
Robust Maximum Likelihood $\chi^2(10)$	15.50	10.06	Robust Maximum Likelihood $\chi^2(10)$	16.04
Root Mean Square Error of Approximation	.04	.01	Root Mean Square Error of Approximation	.04
90% Confidence Interval	.00, .08	.00, .06	90% Confidence Interval	.00, .08
Comparative Fit Index	.98	1.00	Comparative Fit Index	.96
Tucker-Lewis Index	.95	1.00	Tucker-Lewis Index	.91
Standardized Root Mean Square Residual	.03	.03	Standardized Root Mean Square Residual	.04
Construct Reliability			**Reliabilities**	
H	.73	.74	*H*	.73

Note. LDF: Latent difference factor; λ: Standardized factor loadings; Δ: Difference between pre-lockdown and lockdown scores; ω: McDonald's omega coefficient; *H*: Hancock and Mueller's (2001) *H* construct reliability coefficient; * p <.05 ** p <.01; *** p <.001

Descriptive Statistics, Cronbach's alpha values, bivariate associations (i.e. Pearson r values), and multivariate multiple regression analysis results for the PDIF-5-36, domain scales scores and BDI and BAI total scores are reported in Table 3.

Table 3. Personality Inventory for DSM-5 36-Item Brief Form Domain Scale Scores, and Beck Depression Inventory and Beck Anxiety Inventory Total Scores: Descriptive Statistics, Cronbach's Alpha Values, Scale Inter-Correlations (i.e., Pearson r Values), and Multivariate Multiple Regression Analysis Results (N = 307).

	Scale Intercorrelations (i.e., Pearson *r* Values)											Multivariate Regression		
												Dependent Variables		
												BDI	BAI	
	M	*SD*	α	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	β	β	VIF
1. BDI	14.15	10.10	.93	--								--	--	--
2. BAI	14.32	10.63	.92	**.71**	--							--	--	--
PID-5														
3. NA	1.31	0.67	.82	**.56**	**.51**	--						.48*	.43*	1.41
4. De	0.60	0.52	.81	**.39**	**.31**	**.29**	--					.17*	.11	1.42
5. Ant	0.61	0.50	.80	**.28**	**.33**	**.28**	**.33**	--				.04	.15	1.45
6. Dis	0.64	0.53	.81	**.44**	**.38**	**.38**	**.47**	**.43**	--			.12	.12	1.76
7. Psy	0.67	0.58	.86	**.39**	**.30**	**.37**	**.46**	**.48**	**.54**	--		.10	-.02	1.76
8. Ank	1.33	0.72	.89	.13	**.20**	**.41**	**.22**	**.30**	.09	**.32**	--	-.16*	-.06	1.36
R^2												.42***	.33***	
R^2_{adj}												.41***	.32***	

Note. PID-5: Personality Inventory for *DSM-5* 36-Item Brief Form; NA: Negative Affectivity; De: Detachment; Ant: Antagonism; Dis: Disinhibition; Psy: Psychoticism; Ank: Anankastia; BDI: Beck Depression Inventory; BAI: Beck Anxiety Inventory; α: Cronbach's alpha coefficient; β: standardized regression coefficient; VIF: Variance inflation factor; --: Statistic not computed. The nominal significance level (i.e. $p < .05$) for the Pearson *r* coefficients was corrected according to the Bonferroni procedure and set at $p < .0018$; Pearson *r* values $\geq |.18|$ are significant at $p < .0018$. Bold highlights significant *r* values. The nominal significance level (i.e. $p < .05$) for β coefficients was corrected according to the Bonferroni procedure and set at $p < .004$; * $p < .004$. *** $p < .001$.

The results of MIMIC models in which the PID-5-36 domain scale scores, and the BDI and BAI total scores were entered in turn as predictors of the pre-lockdown PSQI component latent factor, lockdown PSQI component latent factor, and PSQI component latent difference factor, respectively, are summarized in Table 4.

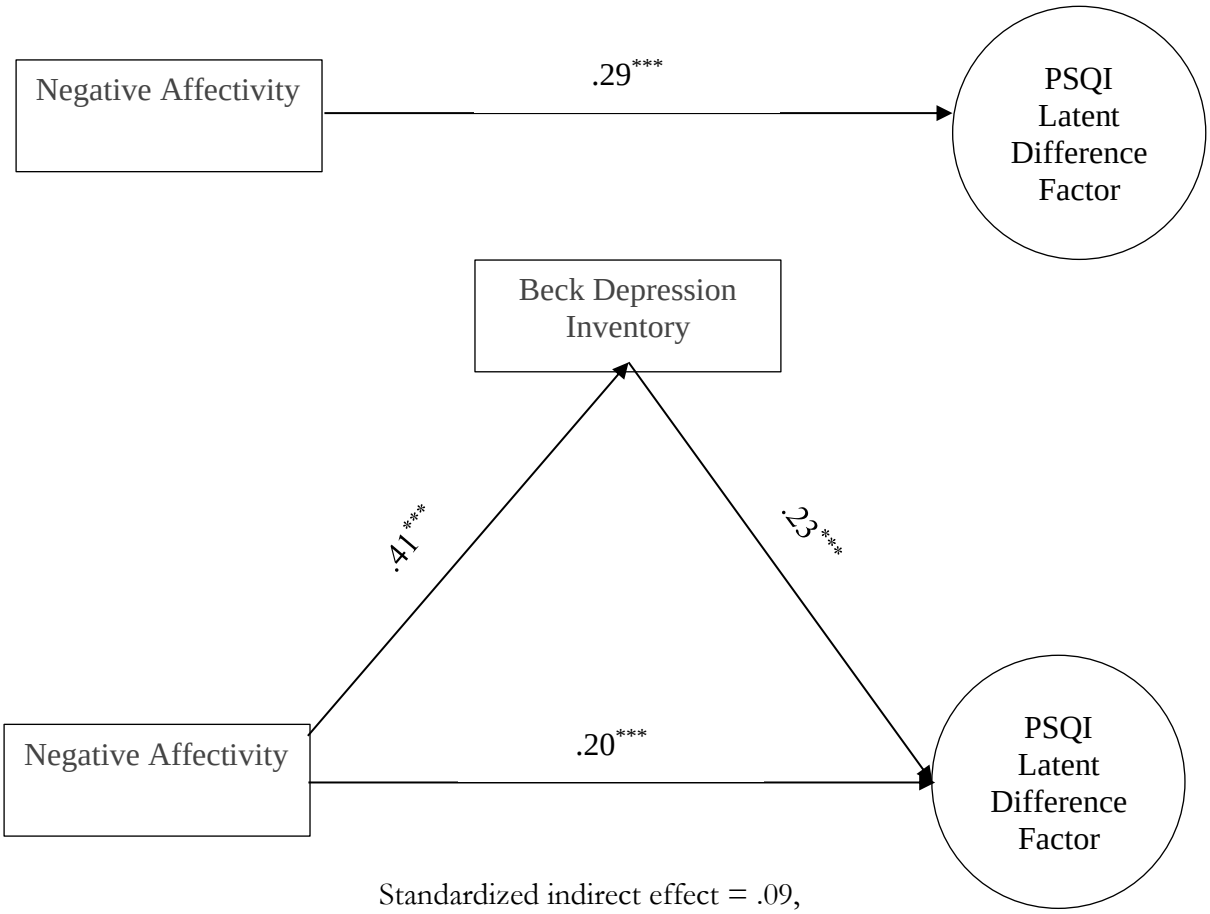
Table 4. Personality Inventory for DSM-5 36-Item Brief Form Domain Scale Scores, and Beck Depression Inventory and Beck Anxiety Inventory Total Scores as Predictors of the Pittsburgh Sleep Quality Index Indicator Pre-Lockdown Factor Scores, Lockdown Factor Scores, and Latent Difference Factor (i.e., Latent Change) Scores In Multiple Indicators, Multiple Causes Models: Standardized Regression Coefficient Summary Table (N = 307).

	Dependent Variable		
	Pittsburgh Sleep Quality Index Pre-Lockdown Factor Scores	Pittsburgh Sleep Quality Index Lockdown Factor Scores	Pittsburgh Sleep Quality Index Latent Difference Factor Scores
Model 1 Predictors	*β*	*β*	*β*
PID-5 Domain Scales			
Negative Affectivity	**.23**	**.46**	**.24**
Detachment	.17	.01	-.05
Antagonism	-.05	-.05	-.08
Disinhibition	.21	**.31**	.16
Psychoticism	.12	.06	-.12
Anankastia	.05	-.02	.01
R^2/ adjusted R^2	$.30^{***}$/ $.28^{***}$	$.44^{***}$/ $.43^{***}$	$.08^{*}$/ $.06^{*}$
Model 2 Predictors			
Beck Depression Inventory	**.23**	**.44**	**.25**
Beck Anxiety Inventory	**.32**	**.37**	.04
R^2/ adjusted R^2	$.26^{***}$/ $.25^{***}$	$.57^{***}$/$.56^{***}$	$.08^{*}$/$.07^{*}$

Note. PID-5: Personality Inventory for DSM-5 36-Item Brief Form; *β*: standardized regression coefficient; within each multiple regression equation, the nominal significance level of the standardized regression coefficients was corrected according to the Bonferroni procedure and set at $p < .0083$ and $p < .025$ for the PID-5 domain scales, and Beck Depression Inventory and Beck Anxiety Inventory, respectively. Bold highlights significant standardized regression coefficients. *** $p < .001$.

Figure 1 displays the results of the mediation analysis of the effect of the BDI total score on the relationship between the PID-5-36 Negative Affectivity scale score and the PSQI latent difference factor.

Figure 1. The Beck Depression Inventory Total Score as Mediator of the Relationship Between the Personality Inventory for DSM-5 36-Item Brief Form Negative Affectivity Domain Scale Score and the Pittsburgh Sleep Quality Inventory Latent Difference Factor Scores in Italian University Students (N = 307).



Standardized indirect effect = .09,

bias-corrected bootstrap 95% confidence interval = .03, .18.

Model $R^2 = .13^*$

Note. PSQI: Pittsburgh Sleep Quality Index. Circles represent latent variables; for ease of presentation the relationship of the latent factor with the PSQI indicators were omitted. The bias-corrected bootstrap 95% confidence interval for standardized indirect effect was based on 10,000 independent bootstrap replications. The significance of the Personality Inventory for *DSM-5* 36-Item Brief Form Negative Affectivity Domain Scale score standardized total effect and direct effect, and the significance of the standardized path coefficient linking the Beck Depression Inventory total score to the PSQI latent difference factor were tested using Wald tests.

* $p < .05$; ** $p < .01$; *** $p < .001$

4. Discussion

Confirming and extending the available literature on the impact of the COVID-19 related lockdown measures on sleep quality, our findings seemed to show that self-reports of selected dysfunctional personality traits were significantly associated with changes in perceived quality of sleep among adult university students during the lockdown in Italy. Although self-reported depressive symptoms were also significantly associated with a decrease in the perceived sleep quality during the lockdown, when compared to pre-lockdown experiences in our university student sample, the relationship between selected dysfunctional personality domains and changes in the perceived quality of sleep was only partially mediated by the severity of self-reported depression.

In our study the pre-lockdown PSQI scores were moderately correlated with the PSQI scores that were based on the lockdown phase (with the partial exception of the PSQI Use of sleep medication component score), suggesting that the two systems of scores were dissociable, albeit related. Rather, our university students reported significantly higher average scores during the lockdown than before the lockdown on five out of the seven PSQI components, as well as on the PSQI total score. Although the effect size estimates for these significant differences were all in the small-to-moderate range by conventional standards (Cohen, 1988), they were highly consistent with the extant literature in suggesting deterioration of perceived sleep quality and increased daytime dysfunction in university students during COVID-19 quarantine measures (Cellini et al., 2020; Tang et al., 2020; Wang et al., 2020), while stressing the need for identifying risk factors for change in sleep quality patterns.

Consistent with Curcio and colleagues' (2013) findings, our data suggested that the PSQI indicators were reliable and factorially valid measures of perceived quality of sleep. Although the Cronbach's alpha values that were observed in our study for the PSQI composite score were at best moderate, it should be observed that Cronbach's alpha coefficients is known to reflect both scale length and inter-item correlation (i.e., the actual internal consistency of the measure; Clark & Watson, 1995). Indeed, in our study median inter-item *r* values for the PSQI were well above the .15 cut-off score for reliable measures (Clark & Watson, 1995). Mostly, it should be observed that all analyses on the relationships between the PSQI and the dysfunctional personality domain measures and internalizing symptoms (i.e., anxiety and depression) self-reports were carried out using latent factor scores. In other terms, we were more interested in the adequacy of the PSQI components as latent factor indicators in SEM analyses (i.e., construct reliability) than in the reliability of the PSQI total scores (Hankock & Mueller, 2001; Rodriguez et al., 2016). In this respect, in our study all *H* index values were greater than the .70 cut-off value (Hankock & Mueller, 2001; Rodriguez et al., 2016).

Consistent with previous data (e.g., Curcio et al., 2013), in our sample a one-factor model of the PSQI components showed adequate fit index values for both the pre-lockdown responses and for the responses that were related to the lockdown phase in Italy. Thus, a latent difference factor for the PSQI could be specified and retained for MIMIC analyses. The possibility to safely estimate a latent change factor allowed us to reliably assess (factor scores are thought to be free of measurement error; Nunnally & Bernstein, 1994) change in perceived sleep quality due to the COVID-19 related lockdown, and to use these reliable change scores as dependent variables in MIMIC model multiple regression and mediation analyses.

Confirming and extending previous data on Neuroticism (Cujipers et al., 2010), in our study Negative Affectivity dysfunctional personality domain, at least as it was operationalized in the PID-5-36, was the main personality predictor of both depression and anxiety symptom self-reports. Interestingly, in our university student sample the pre-lockdown perceived quality of sleep (i.e., PSQI total score) was substantially associated with the PID-5-36 domain scale scores, although only the PID-5-36 Negative Affectivity scale showed a significant unique contribution in predicting the PSQI total score. Similar considerations held also for the role of the PID-5-36 Negative Affectivity scale in predicting the PSQI scores during the lockdown phase, although the PID-5-36 Disinhibition scale – i.e., a measure of poor behavioral restrain (Krueger & Markon, 2014) – represented another significant, non-negligible personality predictor. Not surprisingly, in our sample both depression and anxiety self-reports were significant, positive, and non-trivial predictors of poor sleep quality (i.e., high PSQI total score) both before the lockdown phase and during the lockdown phase.

However, only the BDI total score and the PID-5-36 Negative Affectivity scale score were significant, positive and moderate predictors of the amount of latent change in the perceived quality of sleep from before the lockdown phase to during the lockdown phase. In other terms, the higher the participants propensity towards experiencing a range of negative emotions/emotion dysregulation (i.e., high Negative Affectivity; Krueger & Markon, 2014) and severity of perceived depressive symptoms, the higher the amount of increase in the PSQI latent score – i.e., the poorer the perceived quality of sleep – from before the lockdown phase to during the lockdown phase.

Interestingly, SEM mediation analyses showed that the perceived severity of depressive symptoms, at least as it was operationalized in the BDI total score, represented a significant, albeit partial mediator of the relationship between the PID-5-36 Negative Affectivity domain scale score and the PSQI latent difference factor. Thus, early assessment of perceived depressive symptom severity and self-reported Negative Affectivity may prove clinically useful for

preventive interventions on sleep quality. In this respect, the PID-5-36 represents a short measure that could be easily administered even during quarantine measures to assess dysfunctional personality domains which are likely to represent significant and non-negligible risk factors for poor sleep quality and sleep quality deterioration, at least as they were operationalized in the PSQI total score and latent change in PSQI score, respectively.

4.1 Limitations

Of course, our results should be considered in the light of several limitations.

The prospective nature of our study represents one of the major limitations of our study; future longitudinal studies on this topic are needed to highlight the causal connections between personality, internalizing symptoms, and sleep disturbances. We relied exclusively on self-report measures; our association statistics may have been inflated by shared method variance. Moreover, the negative view of the world/self that characterize depressive symptoms, may have generalized to views of one's sleep quality. However, the fast spreading of the COVID-19 pandemic in Italy and the related quarantine measures prevented us from considering a polysomnographic study on sleep quality in university students. We were forced to rely only to a single measure for each construct; using different measures may possibly lead to different results. However, these characteristics are common to all COVID-19 available literature (e.g., Cellini et al., 2020; Gualano et al., 2020; Marelli et al., 2020; Mazza et al., 2020; Wang et al., 2020). As a whole, these limitations suggest that care should be used in generalizing our findings to the Italian general population.

5. Conclusions

Even keeping these limitations in mind, we feel that our findings extended the available knowledge of the psychological sequelae of quarantine measures (e.g., Brooks et al., 2020; Tang et al., 2020). As a whole, our findings extended previous data on the relationships between sleep disturbances and personality traits (e.g., van de Laar al., 2010), suggesting that examining the role of maladaptive personality traits may prove useful also during the COVID-19 pandemic. Moreover, the results of our study underscore the need for a dimensional approach to the assessment of maladaptive personality traits (Oltmanns, 2019) even during long-term home confinement of masses of people to prevent the COVID-19 from spreading.

Additionally, it should be observed that our data suggested the importance of assessing maladaptive personality traits in association with depressive symptoms in order to prevent persistent sleep disturbances. Indeed, confirming and extending previous research findings on the role of depressive symptoms on sleep quality (e.g., Altena et al., 2020; Gualano et al., 2020),

our data suggested that depression (at least as it was assessed by the BDI total score) was a significant predictor of sleep problems at the end of the lockdown as well as of the amount of latent change in the perceived quality of sleep from before the lockdown phase to during the lockdown phase. From an assessment perspective, evaluating personality traits may prove particularly useful because Negative Affectivity remained a significant predictor of the latent change in PSQI score even when the effect of depressive symptoms was controlled for.

Finally, it should be observed that managing sleep disturbances during home confinement periods can limit stress and possibly prevent disruptions of social relationships (Altena et al., 2020). From an intervention perspective, during the ongoing COVID-19 outbreak, online psychological services and online psychological self-help intervention systems have been developed (e.g., D'Agostino et al., 2020; Liu et al., 2020), and may represent a helpful resource.

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