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The somatic toll of a second lockdown: A prospective study

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ABSTRACT

Objectives To identify mental health prospective trajectories before and after a second lockdown during the COVID-19 pandemic and their association with subsequent somatic symptoms.

Design Prospective Study.

Setting Population based study drawn from an internet panel of 100,000 Israelis.

Participants Adults aged 18 years or more, representative of the adult Israeli population. The participants were measured at two time points (T1 pre-second lockdown N= 1029; Response Rate = 76.17%; T2 post-second lockdown N= 764; Response Rate = 74.24%).

Main outcome measures Trajectories of anxiety and adjustment disorder based on clinical cut-off score for probable diagnoses across T1-T2, Somatic symptoms at T2. The four trajectories: stable-low, (no probable diagnosis), stable-high (stable probable diagnosis), exacerbation (no probable diagnosis at T1, probable diagnosis at T2), recovery (probable diagnosis at T1, no probable diagnosis at T2).

Results Three anxiety trajectories predicted probable somatic symptoms (stable-high OR = 6.45; exacerbation OR = 5.38; recovery OR = 2.03) compared to the stable-low trajectory. The three adjustment disorder trajectories also predicted somatic symptoms (stable-high OR = 4.726; exacerbation OR = 6.419; recovery OR = 4.666) compared to the stable-low trajectory.

Conclusions Our data show the somatic toll of a second lockdown amongst those whose mental health was poor, exacerbated and those who recovered. The presentation of somatic symptoms may mask psychological vulnerabilities, even amongst those who appear to have recovered from the stressor. This indicates that any lockdown may be a double-edged sword and should be carefully administered given these population vulnerabilities.

Key words: COVID-19; Anxiety; Adjustment Disorders; Trajectories; Epidemiology; Mental Health

Article Summary

Strengths and limitations of this study

To our knowledge, this is the first study to address the impact of mental health on somatic symptoms before and after a second lockdown.

Findings are based on a large longitudinal national representative sample enabling identification of mental health trajectories.

The use of validated measures of adjustment disorder, anxiety and somatization, that do not overlap, allows us to report those trajectories of adjustment disorder and anxiety at greater risk of increased somatization.

The main weaknesses of this study are potential selection bias and the lack of measurement of somatic symptoms and mental health indices before the COVID-19 pandemic

Introduction

From a mental health perspective, the COVID-19 pandemic can be viewed as a highly stressful event likely to lead to anxiety and stress related disorders[1]. Particularly interesting, however, are the specific stressors associated with a lockdown, given that such restrictions play such an important role in preventing COVID-19 outbreaks[2]. A number of studies have pointed to an association between a single lockdown and poorer mental health[3,4]. However, in some countries there was more than one lockdown. Israel was one of the first countries to apply a second lockdown, as a result of a rapid infection increase (September 18th to November 8th, 2020). The current study explored trajectories of mental health,[5]and the associations between these trajectories and somatic symptoms over time.

Despite the plethora of studies examining mental health during COVID-19, few studies have addressed adjustment disorder [6,7]. Furthermore, studies regarding the association between mental health and somatic symptoms are scarce using a general population[8,9], although these are commonly reported by patients in both general population and clinical settings[8]. Somatic symptom burden has been related to higher age, lower education, social and economic status, and unemployment[11,12]. Huang et al[9] in China reported a prevalence of 7.59% somatic symptoms in a general population following the COVID-19 outbreak. A high somatic symptom burden has been also associated with reduced subjective health and quality of life, increased psychological distress and use of health care services[10] While these studies have assessed the prevalence of adjustment disorder during the COVID-19 pandemic[6,7], no study thus far has examined a lockdown-related adjustment disorder. Distinguishing this specific disorder is crucial in understanding the relative importance of such a stressor compared to general anxiety during the pandemic. Moreover, to date, no study has examined symptomatology of mental health before and after lockdowns to test for their accumulated burden. As a result, the aforementioned studies lack the prospective perspective of any change and fluctuations that might follow lockdowns.

Empirical research on how mental health and health-related behaviours have changed throughout the COVID-19 pandemic remains limited and is largely based on cross sectional data or prospective data collected before and during the pandemic. Increasing attention has been made to different groupings of responses to this global crisis. A trajectories approach used in longitudinal studies of mental health following potential stressors has identified four main outcome patterns or trajectories over time, namely chronic, recovered, delayed onset and resilient [13,14]. Cross-sectional diagnostic classification can easily overlook these trajectories. For example, recovery may be conflated with resilience or chronic stress depending on when it is assessed. To understand the peri- and post-implications of the COVID-19 crisis, and lockdowns in particular, prospective studies which comprise large nationally representative samples are required. Based on the trajectories approach, the current study suggests four trajectories: a 'stable-low trajectory' which included participants that did not reach the clinical cut-off of anxiety and adjustment disorder at either T1 or T2, a 'recovery trajectory' which included participants that reached full criteria of probable anxiety/probable adjustment disorder at T1, but recovered at T2 and did not reach the clinical cut-offs of anxiety/adjustment disorder; a 'stable-high trajectory' which

included participants that reached full criteria of probable anxiety/probable adjustment disorder at both T1 and T2, and an 'exacerbation trajectory', which includes participants that did not reach criteria of probable anxiety/adjustment disorder at T1 but reached full criteria of probable anxiety/probable adjustment disorder at T2. To date, we know of no prospective studies that have examined the impact of trajectories of mental health on somatic symptoms before and after a second lockdown.

The present study aims to: 1. identify prospective trajectories of anxiety and adjustment disorder before- and- after the second lockdown. 2. examine the predictive impact of anxiety and adjustment disorder during the COVID-19 crisis on somatic symptoms and the probable somatic symptoms burden after the second lockdown.

We hypothesized that lockdown related stable-high and exacerbation trajectories will be associated with greater somatic symptoms, compared to 'recovery' and 'stable-low' trajectories.

Methods

Recruitment and eligibility

Data were collected from August 3 to August 30, 2020 for Time 1 (T1) and November 15th to December 3rd for Time 2 (T2). Eligibility criteria specified that participants should be: aged 18 or over; able to give informed consent; fluent in native language.

Sample size

As a minimum, we estimated that 610 participants would be required to detect low-medium effect sizes of 0.20, with 90% power and a 5% significance level based on inclusion of 12 explanatory variables (6 background variables and 6 trajectories that were compare to the reference group), in a logistic regression model. For the two-way ANOVA we detected a need for 523 minimum sample size, on the basis of 16 groups (4 Adjustment Disorder trajectories X 4 Anxiety trajectories), low-medium effect sizes of 0.20, with 90% power and a 5% significance level. Overall, for logistic regression, a simulation study recommended a minimum sample size of 500 to derive statistics that can represent the parameters in the targeted population[15].

Procedures

We used Israel's iPanel company to deploy a COVID-19 Mental Health Survey. This panel is a probability-based panel with 100,000 members designed to be representative of the adult population in Israel and changes according to the Israeli Bureau of Statistics census. This Study was conducted according to the STROBE guidelines for observational studies. The sample was administered online, and all participants signed an electronic informed consent. The study was approved by first author's Institutional Review Board. In T1, out of 1351 invitations sent, 1029 responded (response rate = 76.17%); in T2, out of 1029 participants in T1 (baseline), 764 responded (response rate = 74.24%). Missing data due to dropout between T1 and T2 were handled using sensitivity analysis that examined differences between participants that dropout and those that participated at both T1 and T2.

Measurements

Anxiety was measured using the Generalized Anxiety Disorder 7-item Scale (GAD-7)[16]. Participants indicate how often they had been bothered by each symptom over the last two weeks on a four-point Likert scale (0 = Not at all, to 3 = Nearly every day). The reliability as measured by Cronbach's alphas was high for both times: T1 (α = .92) and T2 (α = .91). Higher scores indicated higher level of anxiety (ranged score 0-21) and were divided to two categories of anxiety severity (0-9 no probable anxiety; 10-21 probable anxiety).

Adjustment disorder in the form of ICD-11 probable Adjustment Disorder (AjD) was measured using the International Adjustment Disorder Questionnaire 19-item (IADQ)[17]. The IADQ comprises two parts. First is a checklist of a stressors list covering different aspects of life. The second IADQ component assesses adjustment disorder core symptoms (six-items) tapping into two symptoms clusters ('preoccupation' and 'failure to adapt'), functional impairment (three-items) rated on five-point Likert scale (0 = not at all, to 4 = extremely). The tenth question assesses duration of symptoms (coded as 0 for no and 1 for yes). The algorithm for a probable diagnosis of ICD-11 adjustment disorder requires the presence of a psychosocial stressor (score ≥1 on the IADQ stressor list), at least one preoccupation symptom rated ≥ 2, at least one failure-to-adapt symptom rated ≥ 2, and evidence of functional impairment rated ≥ 2. The reliability as measured by Cronbach's alphas in T1 (α = .93) and T2 (α = .94) were excellent.

Somatic symptoms severity was measured using the Somatic Severity Scale 8-item Scale (SSS-8)[18]. Respondents rate how much they were bothered by common somatic symptoms within the last seven days on a five-point Likert scale (0 = Not at all, to 4 = Very much). Higher scores indicated higher level of somatic symptoms (ranged score 0-32) and were divided into five categories of somatic severity (0-3 none-minimal; 4-7 low; 8-11 medium; 12-15 high; 16-32 very high). The reliabilities as measured by Cronbach's alphas in T1 (α = .88) and T2 (α = .88) were very good. For the purpose of this study, we used the cut-off score of ≥ 12 and above for indicating high somatic symptoms severity. The reliability as measured by Cronbach's alphas in T2 (α = .83) was good.

Statistical Methods

We conducted an a-priori sensitivity analyses for each time targeting demographic variables namely age, sex, relationship status, income and education. No significant differences were found between those who answered the survey and those who did not at both T1-T2. The sample mean age was 40.75 (SD = 14.75; range 18-71) with 520 (50.5%) women, 600 (58.3%) men in a committed relationship.

The analytic plan included a descriptive epidemiological approach to depict mental health trajectories across the two assessments, before and after the second lockdown. We used the GAD-7 and IADQ cut-offs in order to determine the trajectories in the current study. Four trajectory groups were generated: (1) participants with no probable anxiety/AjD at both T1-T2 ("stable-low trajectory"); (2) participants with probable anxiety/AjD at both T1-T2 ("stable-high trajectory"); (3) participants with no probable anxiety/AjD at T1 and probable anxiety/AjD at T2 ("exacerbation trajectory"); (4) participants with probable anxiety/AjD at T1 and no probable

anxiety/AjD at T2 ("recovery trajectory"). The rates of each trajectory were identified for both anxiety and adjustment disorder. In order to show the differences between the trajectories which relied on cut offs (dichotomous scores), we present the descriptive information in figures – means of the anxiety and adjustment disorder in the continuous scored of the scales used. Then, we tested the rates of probable somatic symptoms in the different mental health trajectories. In order to characterize the trajectories with respect to demographic data, a multinomial regression on anxiety and adjustment disorder trajectories by background variables was performed.

Second, we addressed the differences between the trajectory groups for both adjustment disorder and anxiety, as well as the combination between them along with their impact on the severity of somatic complaints in T2. A two-way analysis of variance (ANOVA) was conducted. The main effects as well as the interaction effect was calculated.

Third, a logistic regression model examined the outcome variable of probable dichotomous somatic symptoms severity (T2). In the first step, age, sex, relationship status, income, and education were included in the model. Risk group membership for COVID-19 was also added to the model. In the second step, we added the trajectories ΔT1-T2 of both anxiety severity categories and ICD-11 probable AjD. We tested whether the trajectories would significantly contribute to somatic symptoms severity, compared to the stable low trajectory (reference group).

Role of sponsor
The study sponsor did not play a role in the study design, collection; analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

Results

Cohort characteristics

Table 1 summarises the main characteristics of the participants, alongside comparative data on Israeli population values where available. This shows that the demographics were proportionally represented in the sample.

Descriptive information

Prevalence of high somatic severity symptoms was 18.8% (n = 144). Four different trajectories were identified on the basis of score cut-offs for probable anxiety and probable adjustment disorder. The 'stable-low trajectory' included the majority of the sample in both anxiety (78%) and adjustment disorder (71.3%). A second trajectory had the 'recovery' course (9.0% and 8.9% respectively). Of the entire sample, 5.4% and 11.8% belonged to the 'stable-high' trajectory of anxiety and adjustment disorder. A fourth trajectory - the 'exacerbation' trajectory - included 7.5% and 8% in the anxiety and adjustment disorder, respectively. The trajectories of anxiety and adjustment disorder are presented in figures 1-2.

The prevalence rates of the probable somatic severity symptoms in the anxiety trajectories were 11.1%, 61%, 49.1% and 36.2% among the 'stable-low', 'stable high', 'exacerbation', and 'recovery' trajectories, respectively. The prevalence rates of the probable somatic severity symptoms in the

adjustment disorder trajectories were 8.8%, 48.9%, 44.3% and 36.8% among the 'stable-low', 'stable high', 'exacerbation', and 'recovery' trajectories, respectively.

Predicting Trajectories by background variables

A multinomial regression on anxiety trajectories by background variables showed trajectories to be predicted significantly by gender, age and risk group (Table 2). Higher age was significant in predicting the exacerbation groups compared to the stable-low group. High risk for COVID-19 contributed significantly to the high-stable trajectory group (b = .81 se = .08 Wald = 4.54 p = .033 OR=.446 CI 95% .212, .937), compared to the stable-low group. There were more women in the recovery group, compared to the stable-low group (b = -.66 se = .28 Wald = 5.42 p = .033 OR=.519 CI 95% .298, .901).

Adjustment disorder were predicted predominantly by gender and risk group. The COVID-19 risk group contributed significantly to belonging to the stable high (b = .58 se = .27 Wald = 4.67 p = .030 OR=.56 CI 95% .331, .947) and to the exacerbation groups (b = .70 se = .31 Wald = 5.09 p = .024 OR=.50 CI 95% .272, .912) compared to the stable-low group serving as the reference group. There were more women in the trajectory of stable high (b = -.87 se = .25 Wald = 12.51 p < .001 OR=.417 CI 95% .257, .677), and recovery groups (b = -.66 se = .22 Wald = 9.25 p = .003 OR=.52 CI 95% .338, .791) compared to the stable-low group.

Differences between the Trajectories and severity of somatic symptoms

A two-way ANOVA showed significant main effects and non-significant interaction effects. A main effect for the anxiety trajectories demonstrated significant differences between the anxiety trajectories in the severity of somatic symptoms F (3, 748) = 16.723 p < .001, η^2 = .04. The stable low trajectory (M = 8.19 SD = .34) reported significantly lower severity of somatic symptoms compared to the stable-high (M = 13.38 SD = .93), exacerbation (M = 12.34 SD = .69) and recovery (M = 10.02 SD = .60) trajectories. The differences between the stable-low and both the stable-high (Mean difference = -5.19 p<.001) and exacerbation trajectories (Mean difference = -4.15 p<.001) were greater than the difference between the stable-low and the recovery trajectory (Mean difference = -1.89 p=.050).

An ANOVA for the adjustment disorder trajectories showed significant differences between the trajectories in the severity of somatic symptoms F (3, 760) = 17.623 p < .001, η^2 = .05. The stable-low trajectory (M = 8.04 SD = .47) reported significantly lower severity of somatic symptoms compared to the stable-high (M = 12.99 SD = .53), exacerbation (M = 12.07 SD = .82) and recovery (M = 10.83 SD = .80) trajectories. The differences between the stable-low and both the stable-high (Mean difference = -4.96 p<.001) and exacerbation trajectories (Mean difference = -4.03 p<.001) were greater than the difference between the stable-low and the recovery trajectory (Mean difference = -2.79 p=.016).

The interaction between the trajectories of Adjustment disorder and the trajectories of anxiety was not significant F (9, 748) = 1.467 p = .156, η^2 = .01.

The role of mental health trajectories in predicting risk for probable somatic symptoms

A logistic regression found that trajectories of both the anxiety and adjustment disorder were associated with somatic symptoms at T2 (Table 2). Participants with a stable high trajectory, exacerbation trajectory or recovery trajectory had substantially higher odds of having somatic symptoms at T2, compared to participants with a low-stable trajectory.

The odds ratio shows that participants with an exacerbation trajectory in adjustment disorder had the highest odds (OR = 6.419) of experiencing somatic symptoms at T2, compared to the other trajectories (high stable OR = 4.726 and recovery OR = 4.666), all as compared to the stable low trajectory. The statistical difference between the strength of the coefficients of the trajectories was not significant (p ranged .490 and .690).

As for the anxiety trajectories, the stable-high trajectory (or = 6.451) and the exacerbation trajectory (OR = 5.379) had the highest odds ratio for experiencing somatic symptoms at T2, compared to the recovery trajectory that showed lower odds ratio (OR = 2.025), all compared to the group-stable low trajectory. This was reflected further in the statistical difference between the stable-high and the recovery trajectory t(1508) = 227 p = .02 and between the exacerbation and the recovery trajectories t(1508) = 2.09 p = .036.

Discussion

Several studies have suggested that mental health has deteriorated over time in many countries during the pandemic[19-21]. We explored trajectories of anxiety and adjustment disorder before and after the second lockdown during the COVID-19 pandemic in Israel. In line with the existing literature on responses to mass trauma, four types of mental health trajectories were identified: stable-low, stable-high, exacerbation, and recovery groups. These trajectories, with similarities in distribution, have been reported for other disorders, including PTSD[22], and depression and anxiety,[23-24] in different populations[5].

To date, we know of just one, UK-based, study that has examined trajectories of anxiety and depression over the course of the COVID-19 pandemic[25]. However, this UK study focused on the first lockdown only, averaging data into a single slope. Our analysis of multiple events underscored the complex and non-homogenous reactions to lockdowns. Several demographic variables predicted trajectories of response. Being female was a risk factor for more psychopathological trajectories of anxiety and adjustment disorder symptoms for the stable-high trajectory of adjustment disorder and the recovery trajectory of both anxiety and adjustment disorder. Older age was associated with lower odds of belonging to the stable-high or exacerbation trajectories compared to the stable-low trajectory. Risk group membership was associated with higher odds of belonging to the stable-high group of anxiety and adjustment disorder and to the exacerbation group of adjustment disorder.

The current study demonstrated that poor mental health (anxiety and adjustment disorder trajectories) predicted an elevated risk of somatic symptoms burden. For both anxiety and adjustment disorder, affiliation to the stable-high, exacerbation and the recovery T1-T2 trajectories were significantly associated with higher risk for somatic symptoms at T2, compared to the stable-low trajectory. Important to note is that for adjustment disorder the three trajectories predicted somatic symptoms at T2 to a similar magnitude. However, for anxiety, the effect of recovery trajectory on somatic symptoms at T2 was significantly lower in magnitude from the effects of stable-high and exacerbation trajectories on somatic symptoms at that same time point. Adjustment disorder refers to a specific stressor of the lockdown and was reflected in all the three trajectories that differed from the stable-low trajectory. However, the trajectories of anxiety suggested a more general anxiety construct that is global and not stressor specific. Thus, the findings show that adjustment disorder manages to capture the consequences of lockdowns more than anxiety.

In line with our hypotheses, the groups with stable-high and exacerbation trajectories (before- and after – a second lockdown) of anxiety were associated with higher somatic symptoms at T2, compared to the stable-low group. Huang and his colleagues[9] found in their study in China during the COVID-19 breakdown that anxious people were likely to have more somatic symptoms than people without anxiety symptoms. This was also observed through the somatic symptoms burden among those with higher vulnerability to anxiety[25]. Thus, stress can be expressed over time through both emotional and somatic roots, implying that researchers and clinicians should remain open minded regarding the course of symptoms of anxiety and screen for both anxiety and somatization. High stable anxiety and the elevated levels of arousal that accompany such stress conditions can change body sensations and produce physiological changes that may have implications for various symptoms and diseases[26]. Moreover, the COVID-19 pandemic seemed to trigger specific somatic schemata and thoughts of health/illness in particular amongst high anxious people with a more vulnerable anxiety trajectory[27]. Finally, amongst highly anxious individuals with a chronic and exacerbated course, there could be worries that switch between the fear of COVID-19 and the fear of other diseases (somatization), as was shown by almost an equal amount of people (about 30%) who feared an infection with COVID-19 and any other disease at the beginning of the pandemic.

A similar finding emerged with regard to the trajectories of Adjustment disorder; as expected, groups with chronic/stable-high and delayed/exacerbation trajectories (before- and after – a second lockdown) of AjD reported a greater somatic symptoms burden in T2 compared to the stable-low group. One possible explanation might the multifaceted changes that the majority of society experienced due to the cumulative lockdown periods. Adaptability to such rapid and profound change has undoubtedly been a challenging process, suggesting an increase in the stress levels of many individuals associated with somatic symptoms. In line with this notion, it was found that a greater number of psychosocial stressors predict greater somatic symptoms, and that despite the somatic symptoms' high correlation with depression and anxiety, stressors predict somatic symptoms even while controlling for such variables[27]. In the current study items for each of the variables of adjustment disorder, anxiety, and somatic symptoms were distinct, with no overlap between them.

Surprisingly, the recovery group-participants with probable mental health problems (anxiety or AjD) at T1 and no probable mental health at T2, predicted an elevated risk for a somatic symptoms burden, compared to the resilient/stable-low trajectory. One possible explanation may be related to the difference between recovery and resilient trajectories[13]. Hence, while recovery implies a healthy pattern, it suggests less adaptive coping as compared to the resilient stable pattern. Indeed, recovery was found to be a vulnerability point that is stress related and expressed with somatic symptoms. In line with this notion, it might be that the recovery group achieved relief from their fear and worries after the second lockdown, and were better able to cope, as they used positive cognitive emotion strategies to reduce their burden. However, it might be that the duration of employing these strategies was not sufficient as they reported higher somatic symptoms. It may be speculated that the somatic symptoms are an indicator of a vicious cycle that may develop in the future between somatization and anxiety.

Overall, the present findings demonstrate the increased mental health burden associated with the second lockdown during the COVID-19 pandemic. The global crisis of COVID-19 confronts countries with further potential lockdowns. The healthcare system that administered the lockdown and the politicians and public health officials who mandated it should consider carefully the need for such action given the costs to certain vulnerable parts of the society. Our data emphasizes the importance of supporting individuals during lockdown to try to reduce distress, and also the different types of trajectories evident in response to this mass stressor. Our data also shows individuals adapt to the new strains of life in lockdown. Moreover, the present findings highlight the importance of identifying and targeting somatic symptoms as indicators for underlying mental health problems. This may be through primary health physicians who can include somatic symptoms burden screening as part of a patient's visit, especially during crises periods. This may facilitate the management of mental health problems during uncertain times such as the COVID-19 pandemic, and in doing so also save costs. From clinical perspective, interventions should thus be specific to the course of time and take into consideration the specific burden that comes with stress amongst some groups during the lifespan of a mass stressor.

The findings of this study should be considered in the light of several limitations. First, we did not have pre COVID-19 assessments of mental health condition. Second, we did not measure somatic symptoms before the second lockdown was applied (T1). It could be that somatic symptoms burden exacerbated the mental health symptoms. Earlier somatization symptoms may serve as marker of later stress reactions. Finally, reliance on self-report data may liable to recall bias when assessing the occurrence of somatic symptoms.

In conclusion, lockdowns should be seen as complex in terms of their medical and mental health impacts. While lockdowns prevent mass spread of infection, this may be at the cost of mental health. Our study helps to add more evidence to the argument that any lockdown is a double-edged sword.

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Author Contributions

MBE, RG, YHR and YL designed the study concept. MBE RG YHR EL YL wrote the paper. MBE, YHR, EL collected the data. MBE and YL conducted the analyses. MBE, YHR, YL drafted the first version of the manuscript. RG, YHR, EL critically reviewed the manuscript and had a significant intellectual contribution. Authors read and approve the final manuscript. MBE and YL had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved by the Ethics Committee of Ariel University (AU-SOC-YHR-20200616).

Data availability statement All data relevant to the study are included in the article is available upon request to the corresponding author.

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Tables

Table 1. Participant demographics (n = 1029) and Israeli population values

	Participants (n = 1029) n (%)	**Israel population (N = 9,291,000)** n (%)
Gender		
Male	509 (49.5 %)	49.7%
Female	520 (50.5%)	50.3%
Age groups (years)*		
18-22	180 (13.3%)	10.1%
23-29	218 (16.1%)	15.9%
30-39	291 (21.5%)	24%
40-49	240 (17.8%)	20%
50+	422 (31.2%)	30%
Education		
Elementary school	9 (.7%)	1.9%
High school no diploma	132 (9.2)	8%
Graduate high school with diploma	312 (23.1%)	22% **(Graduate high school/ with diploma 42%)**
higher education with no diploma	292 (21.6%)	17%
undergraduate diploma	386 (28.6%)	20% **(Higher diploma - academic/not academic 50.9%)**
post graduate diploma	220 (16.3%)	11%
Income		**Mean income 13,558 NIS**
much below average	281 (21.1%)	26.9%
a little below average	237 (17.8%)	NA
about average	332 (24.9%)	34.1% (based on incomes from all resources to a household)
a little above average	355 (26.7%)	NA **above average – 28%**
much above average	127 (9.5%)	NA
Marital Status		
Single	431 (31.9%)	30%
Married	796 (58.9%)	61%
Divorced	107 (7.9%)	6%
Separated	9 (.7%)	1%
Widowed	8 (.6%)	2%
COVID-19 Risk Group		
Yes	240 (23.3%)	NA
No	789 (76.7%)	NA

Notes. Israel population estimates from Office for National Statistics, end year estimates 2018.

Table 2. Logistic Regression of Factors Predicting Somatic Symptoms burden by SSS-8 (score ≥12)

	n	(%)	b	SE	Wald	p	OR (95% C.I)
Age			-.00	.01	.49	.486	.994 (.978, 1.011)
Sex (reference group: Men)	365	48.8	.45*	.23	4.02	.045	1.574 (1.010, 2.454)
Relationship status (reference group: not in a committed relationship)	299	39.1	-.42	.25	2.92	.088	.654 (.402, 1.065)
Education			.16	.10	2.62	.105	1.170 (.968, 1.416)
Income (Monthly Average: 2,570 GBP (reference group: much lower than average) [a (n= 1014), b (n= 756)]	157	20.5					
A little below average	126	16.5	-.10	.34	.09	.764	.903 (.463-1.759)
About average	193	25.3	-.52	.33	2.51	.113	.594 (.312-1.131)
A little above average	203	26.6	-.24	.33	.52	.469	.790 (.418-1.494)
Much higher than average	77	10.1	-.28	.43	.43	.513	.754 (.323-1.760)
Being in Risk Group for COVID-19 (reference group: not in risk)	581	76.0	-.27	.26	1.08	.298	.761 (.454-1.274)
Trajectories over T1-T2							
GAD-7 Anxiety (reference group: stable low trajectory)	597	78.0			41.291		
Stable high trajectory	41	5.4	1.864***	0.389	22.993	.000	6.451 (3.011, 13.822)
Exacerbation trajectory	57	7.5	1.682***	0.333	25.575	.000	5.379 (2.802, 10.325)
Recovery trajectory	69	9.0	.705*	0.329	4.591	.032	2.025 (1.062, 3.861)
ICD-11 probable Adjustment Disorder by IADQ (reference group: stable low trajectory)	545	71.3			52.853		
Stable high trajectory	90	11.8	1.553***	0.303	26.306	.000	4.726 (2.611, 8.555)
Exacerbation trajectory	61	8.0	1.859***	0.329	31.988	.000	6.419 (3.370, 12.227)
Recovery trajectory	68	8.9	1.540***	0.320	23.161	.000	4.666 (2.492, 8.739)

Note: * p ≤ .05; ** p ≤ .01; *** p ≤ .001. [a]Actual n = 1014; [b]Actual n = 756.

SSS = Somatic Severity Scale; GAD= General Anxiety disorder; IADQ = International Adjustment Disorder Questionnaire.

Figure 1. Trajectories of Anxiety symptoms over time

Notes. Four different trajectories were identified for probable anxiety

'Stable-low trajectory'	'Recovery' trajectory	'Stable-high'	'Exacerbation' trajectory
78%	9.0%	5.4%	7.5%

Figure 2. Trajectories of Adjustment disorder symptoms over time

Notes. Four different trajectories were identified for probable anxiety

'Stable-low trajectory'	'Recovery' trajectory	'Stable-high'	'Exacerbation' trajectory
80.4%	8.4%	6.7%	4.5%

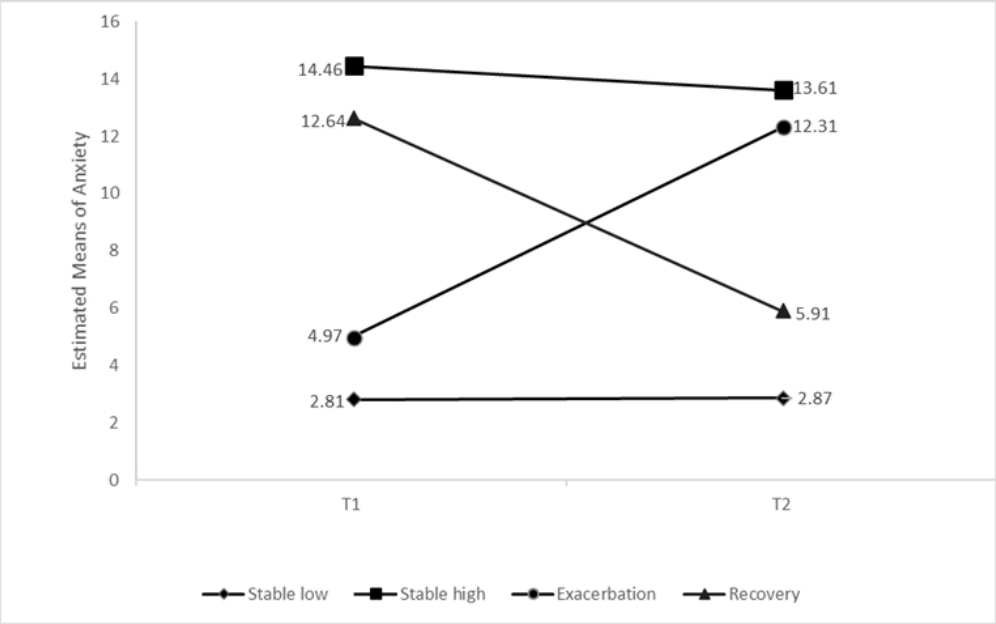

Figure 1. Trajectories of Anxiety symptoms over time

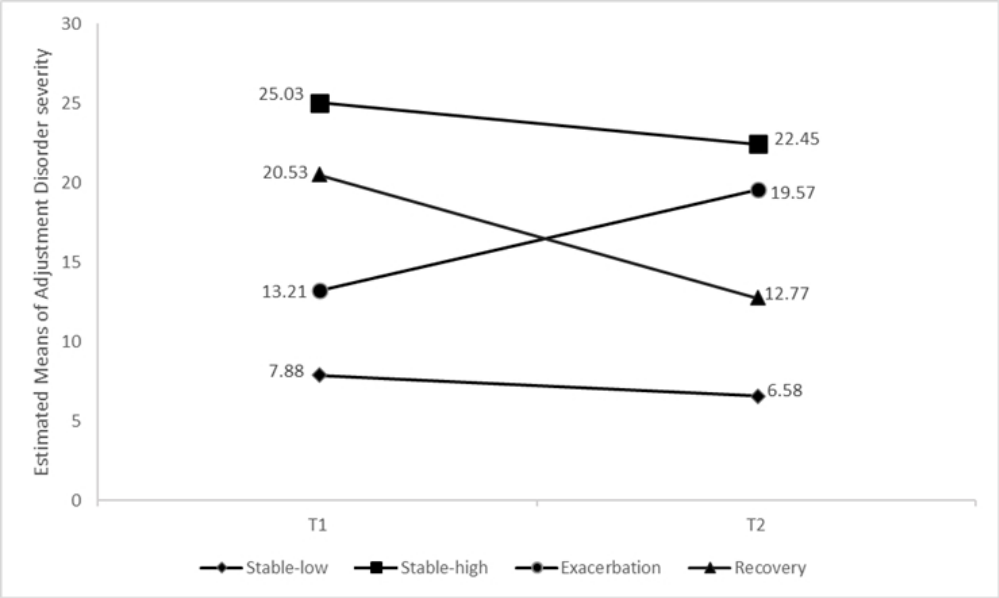

Figure 2. Trajectories of Adjustment disorder symptoms over time

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4-5 (Yafit)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5-6*
Bias	9	Describe any efforts to address potential sources of bias	Yafit
Study size	10	Explain how the study size was arrived at	Yafit
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	5-6
		(*d*) If applicable, explain how loss to follow-up was addressed	5-6
		(*e*) Describe any sensitivity analyses	5-6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yafit (page 4?)
		(b) Give reasons for non-participation at each stage	Yafit (page4 ?)
		(c) Consider use of a flow diagram	No Need
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yafit
		(b) Indicate number of participants with missing data for each variable of interest	Yafit (we have it in table 1) Maybe should add to the paper?
		(c) Summarise follow-up time (eg, average and total amount)	Yafit
Outcome data	15*	Report numbers of outcome events or summary measures over time	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yafit
		(*b*) Report category boundaries when continuous variables were categorized	Yafit
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Yafit
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yafit (Page 4?)
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 7-8
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 8
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 8-9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The association between mental health trajectories and somatic symptoms following a second lockdown in Israel: A longitudinal study

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ABSTRACT

Objectives To identify mental health prospective trajectories before and after a second lockdown during the COVID-19 pandemic and their associations with somatic symptoms.

Design Prospective Study.

Setting Population based study drawn from a probability-based internet panel of over 100,000 Israelis.

Participants Adults aged 18 years or more, representative of the adult Israeli population. The participants were measured at two time points (T1 pre-second lockdown N= 1029; Response Rate = 76.17%; T2 post-second lockdown N= 764; Response Rate = 74.24%).

Main outcome measures Trajectories of anxiety and adjustment disorder based on clinical cut-off score for probable diagnoses across T1-T2, Somatic symptoms at T2. The four trajectories: stable-low, (no probable diagnosis), stable-high (stable probable diagnosis), exacerbation (no probable diagnosis at T1, probable diagnosis at T2), recovery (probable diagnosis at T1, no probable diagnosis at T2).

Results Three anxiety trajectories predicted probable somatic symptoms (stable-high OR = 6.45; exacerbation OR = 5.38; recovery OR = 2.03) compared to the stable-low trajectory. The three adjustment disorder trajectories also predicted somatic symptoms (stable-high OR = 4.726; exacerbation OR = 6.419; recovery OR = 4.666) compared to the stable-low trajectory.

Conclusions Our data show elevated somatic symptoms amongst those whose mental health trajectories were poor, exacerbated and those who recovered following the second lockdown. The presentation of somatic symptoms may mask psychological vulnerabilities, even amongst those who appear to have recovered from the stressor. This indicates that lockdown may be a double-edged sword and should be carefully administered given these populations vulnerabilities.

Key words: COVID-19; Anxiety; Adjustment Disorder; Trajectories; Epidemiology; Mental Health

Article Summary

Strengths and limitations of this study

To our knowledge, this is the first study to address the association of mental health trajectories with somatic symptoms before and after a second lockdown.

The survey used a robust quota sampling method representative of the Israeli adult population based on age and sex.

Findings are based on a large longitudinal national representative sample enabling identification of mental health trajectories.

The use of unrelated robust and validated measures of adjustment disorder, anxiety and somatization allows us to report those trajectories of adjustment disorder and anxiety at higher risk of increased somatic symptoms.

The main weaknesses of this study are potential selection bias and the lack of measurement of somatic symptoms and mental health indices before the COVID-19 pandemic.

Introduction

From a mental health perspective, the COVID-19 pandemic can be viewed as a highly stressful event likely to lead to anxiety and stress related disorders [1]. Particularly interesting, however, are the specific stressors associated with a lockdown, given that such restrictions play such an important role in preventing COVID-19 outbreaks [2]. Several studies have pointed to an association between a single lockdown and poorer mental health [3, 4]. However, in some countries there was more than one lockdown. Israel was one of the first countries to apply a second lockdown, as a result of a rapid infection increase (September 18th to November 8th, 2020). The current study explored trajectories of mental health, [5] and the associations between these trajectories and somatic symptoms over time.

Despite the plethora of studies examining mental health during COVID-19, few studies have addressed adjustment disorder [6, 7]. Furthermore, studies regarding the association between mental health and somatic symptoms are scarce using a general population [8, 9], although these are commonly reported by patients in both general population and clinical settings [8]. Somatic symptom burden has been related to higher age, lower education, social and economic status, and unemployment [10-12]. Huang et al [9] in China reported a prevalence of 7.59% somatic symptoms in a general population following the COVID-19 outbreak. A high somatic symptom burden has been also associated with reduced subjective health and quality of life, increased psychological distress and use of health care services [12] While these studies have assessed the prevalence of adjustment disorder during the COVID-19 pandemic [6, 7], no study thus far has examined a lockdown-related adjustment disorder. Distinguishing this specific disorder is crucial in understanding the relative importance of such a stressor compared to general anxiety during the pandemic. Moreover, to date, no study has examined symptomatology of mental health before and after lockdowns to test for their accumulated burden. As a result, the aforementioned studies lack the prospective perspective of any change and fluctuations that might follow lockdowns.

Empirical research on how mental health and health-related behaviours have changed throughout the COVID-19 pandemic remains limited and is largely based on cross sectional data or very narrow prospective data collected before and during the pandemic. Increasing attention has been made to different groupings of responses to this global crisis. A trajectories approach used in longitudinal studies of mental health following potential stressors has identified four main outcome patterns or trajectories over time, namely chronic, recovered, delayed onset and resilient [13, 14]. Cross-sectional diagnostic classification can easily overlook these trajectories. For example, recovery may be conflated with resilience or chronic stress depending on when it is assessed. To understand the peri- and post-implications of the COVID-19 crisis, and lockdowns in particular, prospective studies which comprise large nationally representative samples are required. Based on the trajectories approach, the current study suggests four trajectories: a 'stable-low trajectory' which included participants that did not reach the clinical cut-off of anxiety and adjustment disorder at either T1 or T2, a 'recovery trajectory' which included participants that reached full criteria of probable anxiety/probable adjustment disorder at T1, but

recovered at T2 and did not reach the clinical cut-offs of anxiety/adjustment disorder; a 'stable-high trajectory' which included participants that reached full criteria of probable anxiety/probable adjustment disorder at both T1 and T2, and an 'exacerbation trajectory', which includes participants that did not reach criteria of probable anxiety/adjustment disorder at T1 but reached full criteria of probable anxiety/probable adjustment disorder at T2. To date, we know of no prospective studies that have examined the impact of trajectories of mental health on somatic symptoms before and after a second lockdown.

This study has several novel characteristics. First it is the first study to estimate mental health before and after a second lockdown. Second. this is one of the first studies to measure trajectories of adjustment disorder based on the newly published ICD-11. Thirdly, this is one of the first studies to measure the association between trajectories of mental health and somatic symptoms.

The present study aims to: 1. identify prospective trajectories of anxiety and adjustment disorder before- and- after the second lockdown. 2. examine the associations of anxiety and adjustment disorder during the COVID-19 crisis with somatic symptoms and probable somatic symptoms after the second lockdown.

We hypothesized that lockdown related stable-high and exacerbation trajectories will be associated with greater somatic symptoms, compared to 'recovery' and 'stable-low' trajectories.

Methods

Recruitment and eligibility

Data were collected from August 3 to August 30, 2020 for Time 1 (T1) and November 15th to December 3rd for Time 2 (T2). Eligibility criteria specified that participants should be: aged 18 or over; Israeli residents at the time the survey was conducted; able to give informed consent; fluent in native language.

Sample size

As a minimum, we estimated that 610 participants would be required to detect low-medium effect sizes of 0.20, with 90% power and a 5% significance level based on inclusion of 12 explanatory variables (six background variables and 6 trajectories that were compared to the reference group), in a logistic regression model. For the two-way ANOVA we detected a need for a 523 minimum sample size, on the basis of 16 groups (4 adjustment disorder trajectories X 4 anxiety trajectories), low-medium effect sizes of 0.20, with 90% power and a 5% significance level. Overall, for logistic regression, a simulation study recommended a minimum sample size of 500 to derive statistics that can represent the parameters in the targeted population [15].

Sampling and Procedures

The study was conducted according to the STROBE guidelines for observational studies.

We used Israel's iPanel company to deploy the COVID-19 Mental Health Survey. This panel is a probability-based panel with over 100,000 members [16]. The panels consist of adults aged 18–

85 who have given their consent to be contacted about surveys. Panel recruitment is dynamic and constant using a range of online methods.

iPanel adheres to the stringent standards of the world association for market, social, and opinion researchers (ESOMAR). From this panel, we recruited participants aged 18-71.

A quota sampling approach was used with quotas meeting the Israeli national census data on age and sex, as specified by the Israeli Bureau of Statistics census data. The use of this approach ensured that a good representation of the adult population in Israel. After the quotas and required sample size were reached, the survey was closed.

The final data set was weighted according to these factors (age and sex) to enable the study to be considered representative of the internet-using participants of 18–71 years living in Israel.

The sample was administered online, and all participants signed an electronic informed consent. The study was approved by first author's Institutional Review Board. At T1, out of 1351 invitations sent, 1029 responded (response rate = 76.17%); at T2, out of 1029 participants in T1 (baseline), 764 responded (response rate = 74.24%). We conducted a set of sensitivity analyses at T1 comparing those who did answer the survey to those who did not (n = 322) on the following key demographic factors age ($t(1049) = 1.10$ $p = .271$), sex ($\chi^2(1) = 2.65$ $p = .104$), marital status ($\chi^2(4) = 1.33$ $p = .856$), income ($\chi^2(4) = 2.77$ $p = .594$), and education ($\chi^2(5) = 6.84$ $p = .145$). No differences were found between the groups.

Measurements

Demographic variables were age (Mean = 40.75; SD = 14.75; range 18-71), Sex coded men as `1` women as `2` (50.5% of the sample, n = 520). Most of the participants were in a committed relationship (58.3% of the sample, n = 600) coded as `1`for single, `2` for committed relationship, `3` for divorced, `4` for separated and `5` for widowed. Education was coded as `1` for elementary school, `2` for high school without diploma, `3` for high school graduate with diploma, `4` for higher education with no diploma, `5` for undergraduate diploma and `6` for post graduate diploma. Income was measured by the following question: "The average monthly income in Israel in August 2020 was 13,558 NIS (2,570 GBP). Please rate your income in comparison". The rating was done on a five-point Likert scale coded as `1` much below average, `2` a little below average, `3` about the average, `4` a little above the average and `5` much above average.

Risk group for COVID-19 was measured by the following question: "do you suffer from one of the following medical conditions: (hypertension, diabetes, cardiovascular disease, chronic respiratory disease, chronic obstructive pulmonary disease and cancer). The list was composed according to the WHO and US CDC. Being in a risk group for COVID-19 was coded as `1` for being a in risk group for COVID-19 and `2` for being in non-risk group for COVID-19. For elaborated demographics, please see Table 1.

Anxiety was measured using the Generalized Anxiety Disorder 7-item Scale (GAD-7) [17]. Participants indicate how often they had been bothered by each symptom over the last two weeks on a four-point Likert scale (0 = Not at all, to 3 = Nearly every day). The reliability as measured

by Cronbach's alphas was high for both times: T1 (α = .92) and T2 (α = .91). Higher scores indicated higher level of anxiety (ranged score 0-21) and were divided to two categories of anxiety severity (0-9 no probable anxiety; 10-21 probable anxiety).

Adjustment disorder in the form of ICD-11 probable adjustment disorder was measured using the International Adjustment Disorder Questionnaire 19-item (IADQ) [18]. The IADQ comprises two parts. First is a checklist of a stressors list covering different aspects of life. The second IADQ component assesses adjustment disorder core symptoms (six-items) tapping into two symptoms clusters ('preoccupation' and 'failure to adapt'), functional impairment (three-items) rated on five-point Likert scale (0 = not at all, to 4 = extremely). The tenth question assesses duration of symptoms (coded as 0 for no and 1 for yes). The algorithm for a probable diagnosis of ICD-11 adjustment disorder requires the presence of a psychosocial stressor (score ≥1 on the IADQ stressor list), at least one preoccupation symptom rated ≥ 2, at least one failure-to-adapt symptom rated ≥ 2, and evidence of functional impairment rated ≥ 2. The reliability as measured by Cronbach's alphas in T1 (α = .93) and T2 (α = .94) were excellent.

Somatic symptoms severity was measured using the Somatic Severity Scale 8-item Scale (SSS-8) [19]. Respondents rated how much they were bothered by common somatic symptoms within the last seven days on a five-point Likert scale (0 = Not at all, to 4 = Very much). Higher scores indicated higher level of somatic symptoms (ranged score 0-32) and were divided into five categories of somatic severity (0-3 none-minimal; 4-7 low; 8-11 medium; 12-15 high; 16-32 very high). The reliabilities as measured by Cronbach's alphas in T1 (α = .88) and T2 (α = .88) were very good. For the purpose of this study, we used the cut-off score of ≥ 12 and above for indicating high somatic symptoms severity. The reliability as measured by Cronbach's alphas in T2 (α = .83) was good.

Statistical Methods

Following the conducted an a-priori sensitivity analyses targeting demographic variables namely age, sex, relationship status, income and education showing no significant differences were found between those who answered the survey and those who did not.

The analytic plan included a descriptive epidemiological approach to depict mental health trajectories across the two assessments, before and after the second lockdown. We used the GAD-7 and IADQ cut-offs in order to determine the trajectories in the current study. Four trajectory groups were generated: (1) participants with no probable anxiety/adjustment disorder at both T1-T2 ("stable-low trajectory"); (2) participants with probable anxiety/adjustment disorder at both T1-T2 ("stable-high trajectory"); (3) participants with no probable anxiety/adjustment disorder at T1 and probable anxiety/adjustment disorder at T2 ("exacerbation trajectory"); (4) participants with probable anxiety/adjustment disorder at T1 and no probable anxiety/adjustment disorder at T2 ("recovery trajectory"). The rates of each trajectory were identified for both anxiety and adjustment disorder. In order to show the differences between the trajectories which relied on cut offs (dichotomous scores), we present the descriptive information in figures – means of the anxiety and adjustment disorder in the continuous scored of the scales used. Then, we tested the rates of probable somatic symptoms in the different mental health trajectories. In order to characterize the trajectories with respect to demographic data, a

multinomial regression on anxiety and adjustment disorder trajectories by background variables was performed.

Second, we addressed the differences between the trajectory groups for both adjustment disorder and anxiety, as well as the combination between them along with their impact on the severity of somatic complaints in T2. A two-way analysis of variance (ANOVA) was conducted. The main effects as well as the interaction effect was calculated.

Third, a logistic regression model examined the outcome variable of probable dichotomous somatic symptoms severity (T2). In the first step, age, sex, relationship status, income, and education were included in the model. Risk group membership for COVID-19 was also added to the model. In the second step, we added the trajectories ΔT1-T2 of both anxiety severity categories and ICD-11 probable adjustment disorder. We tested whether the trajectories would significantly contribute to somatic symptoms severity, compared to the stable low trajectory (reference group).

Role of sponsor

The study sponsor did not play a role in the study design, collection; analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

Patient and Public Involvement

No patient involved.

Results

Cohort characteristics

Table 1 summarises the main characteristics of the participants, alongside comparative data on Israeli population values where available. This shows that the demographics were proportionally represented in the sample.

Descriptive information

Prevalence of high somatic severity symptoms was 18.8% (n = 144). Four different trajectories were identified on the basis of score cut-offs for probable anxiety and probable adjustment disorder. The 'stable-low trajectory' included the majority of the sample in both anxiety (78%) and adjustment disorder (71.3%). A second trajectory had the 'recovery' course (9.0% and 8.9% respectively). Of the entire sample, 5.4% and 11.8% belonged to the 'stable-high' trajectory of anxiety and adjustment disorder. A fourth trajectory - the 'exacerbation' trajectory - included 7.5% and 8% in the anxiety and adjustment disorder, respectively. The trajectories of anxiety and adjustment disorder are presented in figures 1 & 2.

The prevalence rates of the probable somatic severity symptoms in the anxiety trajectories were 11.1%, 61%, 49.1% and 36.2% among the 'stable-low', 'stable high', 'exacerbation', and 'recovery' trajectories, respectively. The prevalence rates of the probable somatic severity symptoms in the adjustment disorder trajectories were 8.8%, 48.9%, 44.3% and 36.8% among the 'stable-low', 'stable high', 'exacerbation', and 'recovery' trajectories, respectively.

Predicting Trajectories by background variables

A multinomial regression on anxiety trajectories by background variables showed trajectories to be predicted significantly by sex, age and risk group, See Table 2. Higher age was significant in predicting the exacerbation groups compared to the stable-low group. High risk for COVID-19 contributed significantly to the high-stable trajectory group (b = 0.81, se = 0.08, Wald = 4.54, p = 0.033, odds ratio (OR) 0.446, 95% confidence interval (CI) 0.212 to 0.937), compared to the stable-low group. There were more women in the recovery group, compared to the stable-low group (b = -0.66, se = 0.28, Wald = 5.42, p = 0.033, OR 0.519, 95% CI 0.298 to 0.901).

Adjustment disorder were predicted predominantly by sex and risk group. The COVID-19 risk group contributed significantly to belonging to the stable high (b = 0.58, se = 0.27, Wald = 4.67, p = 0.030, OR 0.56, 95% CI 0.331 to 0.947) and to the exacerbation groups (b = 0.70, se = 0.31, Wald = 5.09, p = 0.024, OR 0.50, 95% CI 0.272 to 0.912) compared to the stable-low group serving as the reference group. There were more women in the trajectory of stable high (b = -0.87, se = 0.25, Wald = 12.51, p < 0.001, OR 0.417, 95% CI 0.257 to 0.677), and recovery groups (b = -0.66, se = 0.22, Wald = 9.25, p = 0.003, OR 0.52, 95 CI 0.338 to 0.791) compared to the stable-low group.

Differences between the Trajectories and severity of somatic symptoms

A two-way ANOVA showed significant main effects and non-significant interaction effects. A main effect for the anxiety trajectories demonstrated significant differences between the anxiety trajectories in the severity of somatic symptoms $F(3, 748) = 16.723$, $p < 0.001$, $\eta^2 = 0.04$. The stable low trajectory (M = 8.19, SD = 0.34) reported significantly lower severity of somatic symptoms compared to the stable-high (M = 13.38, SD = 0.93), exacerbation (M = 12.34, SD = 0.69) and recovery (M = 10.02, SD = 0.60) trajectories. The differences between the stable-low and both the stable-high (Mean difference = -5.19, p < 0.001) and exacerbation trajectories (Mean difference = -4.15, p < 0.001) were greater than the difference between the stable-low and the recovery trajectory (Mean difference = -1.89, p = 0.050).

An ANOVA for the adjustment disorder trajectories showed significant differences between the trajectories in the severity of somatic symptoms $F(3, 760) = 17.623$, $p < 0.001$, $\eta^2 = 0.05$. The stable-low trajectory (M = 8.04, SD = 0.47) reported significantly lower severity of somatic symptoms compared to the stable-high (M = 12.99, SD = 0.53), exacerbation (M = 12.07, SD = 0.82) and recovery (M = 10.83, SD = 0.80) trajectories. The differences between the stable-low and both the stable-high (Mean difference = -4.96, p < 0.001) and exacerbation trajectories (Mean difference = -4.03, p < 0.001) were greater than the difference between the stable-low and the recovery trajectory (Mean difference = -2.79, p = 0.016).

The interaction between the trajectories of adjustment disorder and the trajectories of anxiety was not significant $F(9, 748) = 1.467$, $p = 0.156$, $\eta^2 = 0.01$.

The role of mental health trajectories in predicting risk for probable somatic symptoms

A logistic regression found that trajectories of both the anxiety and adjustment disorder were associated with somatic symptoms at T2 (Table 2). Participants with a stable high trajectory, exacerbation trajectory or recovery trajectory had substantially higher odds of having somatic symptoms at T2, compared to participants with a low-stable trajectory.

The odds ratio shows that participants with an exacerbation trajectory in adjustment disorder had the highest odds (OR 6.419) of experiencing somatic symptoms at T2, compared to the other trajectories (high stable OR 4.726 and recovery OR 4.666), all as compared to the stable low trajectory. The statistical difference between the strength of the coefficients of the trajectories was not significant (p value ranged from 0.490 to 0.690).

As for the anxiety trajectories, the stable-high trajectory (OR 6.451) and the exacerbation trajectory (OR 5.379) had the highest odds ratio for experiencing somatic symptoms at T2, compared to the recovery trajectory that showed lower odds ratio (OR 2.025), all compared to the group-stable low trajectory. This was reflected further in the statistical difference between the stable-high and the recovery trajectory $t(1508) = 2.27$, $p = 0.02$ and between the exacerbation and the recovery trajectories $t(1508) = 2.09$, $p = 0.036$.

Discussion

Several studies have suggested that mental health has deteriorated over time in many countries during the pandemic [20-22]. We explored trajectories of anxiety and adjustment disorder before and after the second lockdown during the COVID-19 pandemic in Israel. In line with the existing literature on responses to mass trauma, four types of mental health trajectories were identified: stable-low, stable-high, exacerbation, and recovery groups. These trajectories, with similarities in distribution, have been reported for other disorders including PTSD [23], depression and anxiety [24, 25], in different populations [5].

To date, we know of just one, UK-based, study that has examined trajectories of anxiety and depression over the course of the COVID-19 pandemic [26]. However, this UK study focused on the first lockdown only, averaging data into a single slope. Our analysis of multiple events underscored the complex and non-homogenous reactions to lockdowns. Several demographic variables predicted trajectories of response. Being female was a risk factor for more psychopathological trajectories of anxiety and adjustment disorder symptoms for the stable-high trajectory of adjustment disorder and the recovery trajectory of both anxiety and adjustment disorder. Older age was associated with lower odds of belonging to the stable-high or exacerbation trajectories compared to the stable-low trajectory. Risk group membership was associated with higher odds of belonging to the stable-high group of anxiety and adjustment disorder and to the exacerbation group of adjustment disorder.

The current study showed the association of poor mental health (anxiety and adjustment disorder trajectories) with elevated risk of somatic symptoms burden. For both anxiety and adjustment disorder, affiliation to the stable-high, exacerbation and the recovery T1-T2 trajectories were significantly associated with higher risk for somatic symptoms at T2, compared to the stable-low

trajectory. Important to note is that for adjustment disorder the three trajectories were associated with somatic symptoms at T2 to a similar magnitude. However, for anxiety, the association of recovery trajectory with somatic symptoms at T2 was significantly lower than the associations of stable-high and exacerbation trajectories with somatic symptoms at that same time point. Adjustment disorder refers to a specific stressor of the lockdown and was reflected in all the three trajectories that differed from the stable-low trajectory. However, the trajectories of anxiety suggested a more general anxiety construct that is global and not stressor specific. Thus, the findings show that adjustment disorder manages to capture the consequences of lockdowns more than anxiety.

In line with our hypotheses, the groups with stable-high and exacerbation trajectories (before- and after – a second lockdown) of anxiety were associated with higher somatic symptoms at T2, compared to the stable-low group. Huang and his colleagues [9] found in their study in China during the COVID-19 breakdown that anxious people were likely to have more somatic symptoms than people without anxiety symptoms. This was also observed through the somatic symptoms burden among those with higher vulnerability to anxiety [26]. Thus, stress can be expressed over time through both emotional and somatic roots, implying that researchers and clinicians should remain open minded regarding the course of symptoms of anxiety and screen for both anxiety and somatization. High stable anxiety and the elevated levels of arousal that accompany such stress conditions can change body sensations and produce physiological changes that may have implications for various symptoms and diseases [27]. Moreover, the COVID-19 pandemic seemed to trigger specific somatic schemata and thoughts of health/illness in particular amongst high anxious people with a more vulnerable anxiety trajectory [27]. Finally, amongst highly anxious individuals with a chronic and exacerbated course, there could be worries that switch between the fear of COVID-19 and the fear of other diseases (somatization), as was shown by almost an equal amount of people (about 30%) who feared an infection with COVID-19 and any other disease at the beginning of the pandemic.

A similar finding emerged with regard to the trajectories of adjustment disorder; as expected, groups with chronic/stable-high and delayed/exacerbation trajectories (before- and after – a second lockdown) of adjustment disorder reported a greater somatic symptoms burden in T2 compared to the stable-low group. One possible explanation might the multifaceted changes that the majority of society experienced due to the cumulative lockdown periods. Adaptability to such rapid and profound change has undoubtedly been a challenging process, suggesting an increase in the stress levels of many individuals associated with somatic symptoms. In line with this notion, it was found that a greater number of psychosocial stressors predict greater somatic symptoms, and that despite the somatic symptoms' high correlation with depression and anxiety, stressors predict somatic symptoms even while controlling for such variables [28]. In the current study items for each of the variables of adjustment disorder, anxiety, and somatic symptoms were distinct, with no overlap between them.

Surprisingly, the recovery group-participants with probable mental health problems (anxiety or adjustment disorder at T1 and no probable mental health at T2), was associated with elevated risk for a somatic symptoms burden, compared to the resilient/stable-low trajectory. One possible explanation may be related to the difference between recovery and resilient trajectories [13]. Hence, while recovery implies a healthy pattern, it suggests less adaptive coping as compared to

the resilient stable pattern. Indeed, recovery was found to be a vulnerability point that is stress related and expressed with somatic symptoms. In line with this notion, it might be that the recovery group achieved relief from their fear and worries after the second lockdown, and were better able to cope, as they used positive cognitive emotion strategies to reduce their burden. However, it might be that the duration of employing these strategies was not sufficient as they reported higher somatic symptoms. It may be speculated that the somatic symptoms are an indicator of a vicious cycle that may develop in the future between somatization and anxiety.

Overall, the present findings report that increased mental health burden was associated with the second lockdown during the COVID-19 pandemic. The global crisis of COVID-19 confronts countries with further potential lockdowns. The healthcare system that administered the lockdown and the politicians and public health officials who mandated it should carefully consider the need for such action given the costs to certain vulnerable parts of the society. Our data emphasizes the importance of supporting individuals during lockdown to try to reduce distress, and the different types of trajectories evident in response to this mass stressor. Our data also shows individuals adapt to the new strains of life in lockdown. Moreover, the present findings may point to the importance of identifying and targeting somatic symptoms as indicators for association with mental health problems. This may be through primary health physicians who can include somatic symptoms burden screening as part of a patient's visit, especially during crisis period. This may facilitate the management of mental health problems during uncertain times such as the COVID-19 pandemic, and in doing so also reduce costs. From clinical perspective, interventions should thus be specific to the course of time and take into consideration the specific burden that comes with stress amongst some groups during the lifespan of a mass stressor.

Discussion of methodology

We employed an online survey using quota sampling from a probability-based internet panel representative of the Israeli population. This had several advantages

First, internet penetration in Israel as of January 2021 is 88.0% (7.68 million out of 8.72 million) and percentage of mobile connections in Israel as of January 2021 is 116.9% (10.2 million out of 8.72 million) as some people have more than one mobile phone (https://datareportal.com/reports/digital-2021-israel).

Second, online surveys have become important during the COVID-19 pandemic as traditional survey methods were not feasible [29].

Third, obtaining high quality behavioural data or mental health data in a longitudinal design during COVID-19 pandemic is still scarce [29].

Fourth, an online survey enabled us to collect real-time data regarding health and mental health [29].

Fifth online surveys can be created and deployed in very short time in comparison to traditional surveys [29]. This is particularly important during an ongoing pandemic situation where the

number of external factors (e.g., infection rates and governmental responses to these) change rapidly.

Sixth, people feel less reluctant to disclose sensitive information in an online format [30].

However, all these benefits come with at the risk of selection bias. Selection bias can be reduced by using probability panels in countries with high internet penetration and high mobile connectivity. Using an online survey taken from a probability panel will have higher external validation and better generalization for the general population in comparison to online surveys taken from non-probabilistic panel and countries with low internet penetration and mobile connectivity.

To sum, during COVID-19 pandemic, online surveys proved their value in collecting medical and mental health data. While the problem of selection bias still exists, the benefits and potential solutions to reduce this bias are justifying the use of online surveys.

Limitations

The findings of this study should be considered in the light of several limitations. First is selection bias. However, using a probability-based internet panel that is weighted and dynamically adjusted to meet the Israeli Bureau of Statistics in terms of age and sex in a country with high internet penetration and mobile connections is one way to reduce selection bias. Second, while random stratified sampling is often preferable in comparison to quota sampling, the use of robust quota sampling enables a high response rate based for probability-based internet panel representatives of the Israeli internet user population. This is highly valuable in longitudinal designs. Contrary to this, use of random stratified sampling tend to yield lower a response rate. A previous study based on the same probability-based internet panel using a random stratification sampling led to 31.00% response rate [16] vs. 76.17% response rate in the current study. We note that a probability sample with low response rate suffers from the same potential bias as a non-probability sample and therefore enjoys no clear advantage over a quota sample [31].

Study design considerations related to probability panels and real-time assessments can potentially reduce bias and increase the rigor of online surveys.

Most importantly, quota samples that reflect the general population can be deployed when time constraints exist such as lockdowns during COVID-19 pandemic. Using stratified random samples before and after a second lockdown could easily lead to missing the time window for sampling. Moreover, the COVID-19 pandemic increased the homogeneity in the population related to the shared experience of the pandemic. In such conditions wherein homogeneity increases, the quota sampling has further advantages, and it was found to have similar estimates compared to probability sample [32].

In addition, we did not have pre COVID-19 assessments of mental health condition. We did not measure somatic symptoms before the second lockdown was applied (T1). It could be those somatic symptoms burden exacerbated the mental health symptoms. Earlier somatization

symptoms may serve as marker of later stress reactions. Finally, reliance on self-report data may be liable to recall bias when assessing the occurrence of mental health symptoms.

In conclusion, lockdowns should be viewed as multifaceted in terms of medical and mental health impacts. While lockdowns prevent mass spread of infection, this may be at the cost of mental health. Our study strengthens the argument that a lockdown during a pandemic is a double-edged sword.

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Author Contributions

MBE, RG, YHR and YL designed the study concept. MBE RG YHR EL YL wrote the paper. MBE, YHR, EL collected the data. MBE and YL conducted the analyses. MBE, YHR, YL drafted the first version of the manuscript. RG, YHR, EL critically reviewed the manuscript and had a significant intellectual contribution. Authors read and approve the final manuscript. MBE and YL had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved by the Ethics Committee of Ariel University (AU-SOC-YHR-20200616).

Data availability statement All data relevant to the study are included in the article is available upon request to the corresponding author.

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Tables

Table 1. Participant demographics (n = 1029) and Israeli population values

	Participants (n = 1029) n (%)	**Israel population (N = 9,291,000)** n (%)
Sex		
Male	509 (49.5 %)	49.7%
Female	520 (50.5%)	50.3%
Age groups (years)*		
18-22	180 (13.3%)	10.1%
23-29	218 (16.1%)	15.9%
30-39	291 (21.5%)	24%
40-49	240 (17.8%)	20%
50+	422 (31.2%)	30%
Education		
Elementary school	9 (.7%)	1.9%
High school no diploma	132 (9.2%)	8%
Graduate high school with diploma	312 (23.1%)	22% **(Graduate high school/ with diploma 42%)**
higher education with no diploma	292 (21.6%)	17%
undergraduate diploma	386 (28.6%)	20% **(Higher diploma - academic/not academic 50.9%)**
post graduate diploma	220 (16.3%)	11%
Income		**Mean income 13,558 NIS (2,570 GBP)**
much below average	281 (21.1%)	26.9%
a little below average	237 (17.8%)	N/A
about average	332 (24.9%)	34.1% (based on incomes from all resources to a household)
a little above average	355 (26.7%)	N/A **above average – 28%**
much above average	127 (9.5%)	N/A
Marital Status		
Single	431 (31.9%)	30%
Married	796 (58.9%)	61%
Divorced	107 (7.9%)	6%
Separated	9 (.7%)	1%
Widowed	8 (.6%)	2%
COVID-19 Risk Group according to the WHO criteria.		
Yes	240 (23.3%)	N/A
No	789 (76.7%)	N/A

Notes. Israel population estimates from Office for National Statistics, end year estimates 2018.

Table 2. Logistic Regression of Factors Predicting Somatic Symptoms burden by SSS-8 (score ≥12)

	n	(%)	b	SE	Wald	p	OR (95% C.I)
Age			-.00	.01	.49	.486	.994 (.978, 1.011)
Sex (reference group: Men)	365	48.8	.45*	.23	4.02	.045	1.574 (1.010, 2.454)
Relationship status (reference group: not in a committed relationship)	299	39.1	-.42	.25	2.92	.088	.654 (.402, 1.065)
Education			.16	.10	2.62	.105	1.170 (.968, 1.416)
Income (Monthly Average: 2,570 GBP) (reference group: much lower than average) [a (n= 1014), b (n= 756)]	157	20.5					
A little below average	126	16.5	-.10	.34	.09	.764	.903 (.463-1.759)
About average	193	25.3	-.52	.33	2.51	.113	.594 (.312-1.131)
A little above average	203	26.6	-.24	.33	.52	.469	.790 (.418-1.494)
Much higher than average	77	10.1	-.28	.43	.43	.513	.754 (.323-1.760)
Being in Risk Group for COVID-19 (reference group: not in risk)	581	76.0	-.27	.26	1.08	.298	.761 (.454-1.274)
Trajectories over T1-T2							
GAD-7 Anxiety (reference group: stable low trajectory)	597	78.0			41.291		
Stable high trajectory	41	5.4	1.864***	0.389	22.993	.000	6.451 (3.011, 13.822)
Exacerbation trajectory	57	7.5	1.682***	0.333	25.575	.000	5.379 (2.802, 10.325)
Recovery trajectory	69	9.0	.705*	0.329	4.591	.032	2.025 (1.062, 3.861)
ICD-11 probable Adjustment Disorder by IADQ (reference group: stable low trajectory)	545	71.3			52.853		
Stable high trajectory	90	11.8	1.553***	0.303	26.306	.000	4.726 (2.611, 8.555)
Exacerbation trajectory	61	8.0	1.859***	0.329	31.988	.000	6.419 (3.370, 12.227)
Recovery trajectory	68	8.9	1.540***	0.320	23.161	.000	4.666 (2.492, 8.739)

Note: * p ≤ .05; ** p ≤ .01; *** p ≤ .001. [a]Actual n = 1014; [b]Actual n = 756.

SSS = Somatic Severity Scale; GAD= General Anxiety disorder; IADQ = International Adjustment Disorder Questionnaire.

Figure 1. Trajectories of Anxiety symptoms over time

Notes. Four different trajectories were identified for probable anxiety.

Figure 2. Trajectories of Adjustment disorder symptoms over time

Notes. Four different trajectories were identified for probable anxiety.

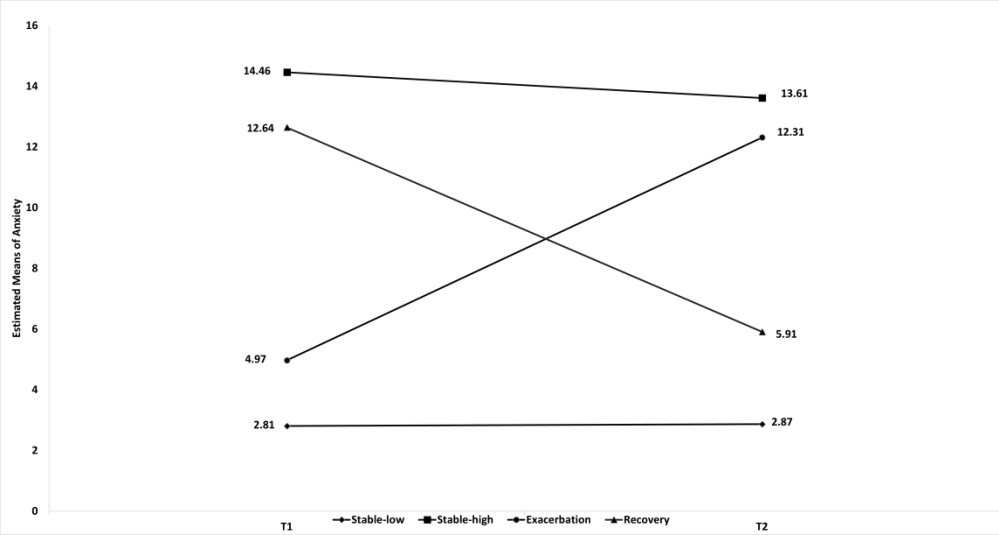

Figure 1. Trajectories of Anxiety symptoms over time

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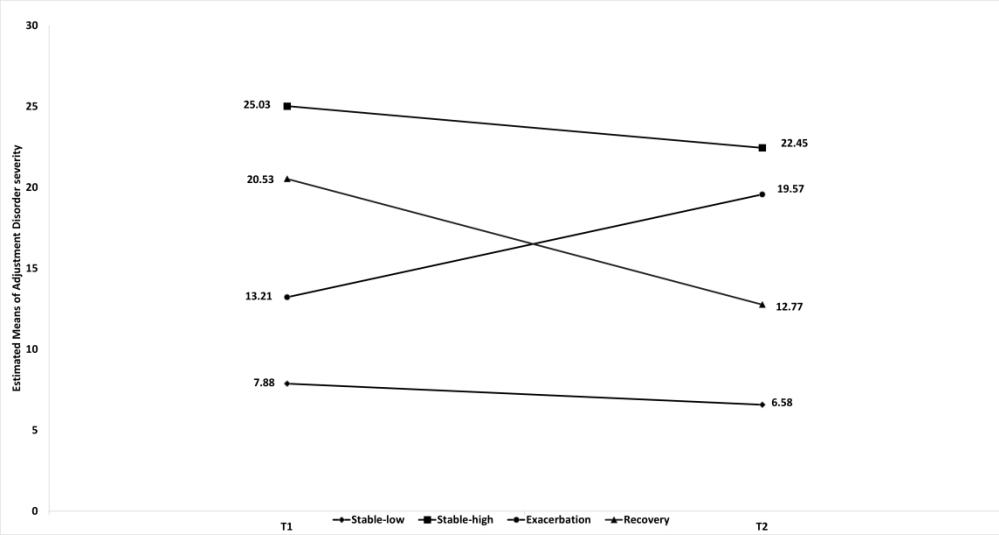

Figure 2. Trajectories of Adjustment disorder symptoms over time

1046x560mm (130 x 130 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4-5 (Yafit)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5-6*
Bias	9	Describe any efforts to address potential sources of bias	Yafit
Study size	10	Explain how the study size was arrived at	Yafit
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	5-6
		(*d*) If applicable, explain how loss to follow-up was addressed	5-6
		(*e*) Describe any sensitivity analyses	5-6
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Yafit (page 4?)
		(b) Give reasons for non-participation at each stage	Yafit (page4 ?)
		(c) Consider use of a flow diagram	No Need
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yafit
		(b) Indicate number of participants with missing data for each variable of interest	Yafit (we have it in table 1) Maybe should add to the paper?
		(c) Summarise follow-up time (eg, average and total amount)	Yafit
Outcome data	15*	Report numbers of outcome events or summary measures over time	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Yafit
		(*b*) Report category boundaries when continuous variables were categorized	Yafit
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Yafit
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yafit (Page 4?)
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 7-8
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 8
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 8
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 8-9

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.