Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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The effect of exercise and affect regulation skills on mental health during the COVID-19 pandemic: A cross-sectional survey

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ABSTRACT

Background: COVID-19-related confinements pose a threat to mental health. We investigated prevalence rates of symptoms of depression, generalized anxiety and insomnia in German adults. Furthermore, we explored associations of exercise behavior with disorder-specific symptoms and assessed whether specific affect regulation skills enhance the effect of exercise on symptom alleviation.

Methods: Cross-sectional survey-based data collected during the first lockdown is presented: 4268 adults completed questionnaires on mental health, exercise behavior and Covid-related lifestyle factors. Primary outcome was depression (PHQ-9), secondary outcomes generalized anxiety (PHQ-D) and sleep quality (PSQI). Multiple linear regression analyses were performed to examine the association of exercise behavior with the outcomes.

Results: Analyses resulted in elevated symptoms of psychological distress (probable cases of depressive disorder: 31.2%, anxiety disorder: 7.5%, sleeping disorder: 43.0%). A change towards less exercise during the lockdown was significantly associated with higher levels of depression (t=5.269; β=0.077, p<.001), anxiety (t=3.397; β=0.055, p<.001) and insomnia (t=3.466; β=0.058; p<.001). Physical activity (PA)-related affect regulation enhanced the effect of exercise on mental health.

Conclusion: Results suggest a demand for measures which promote the maintenance of exercise during a pandemic and improve PA-related affect regulation to optimize effects of exercise on mental health.

1. Introduction

In March 2020, the coronavirus disease 2019 (COVID-19) had reached all countries of the Western world (Bönisch et al., 2020). To prevent the spread of the virus, Germany followed the recommendations issued by the World Health Organization to enforce restrictions on public life and to promote self-isolation (WHO, 2020): On March 16th, 2020, all federal states declared a shutdown of non-essential businesses. As of March 22, 2020, public gatherings of more than two persons not living in the same household were banned resulting in a (partial) lockdown (22 March - 19 April, with relaxed restrictions extended until 26 April) (Gostin and Wiley, 2020; Robert Koch Institute, 2020).

While implementing restrictive measures are vital to contain the virus, they also heavily affect daily life and impact mental health (Brooks et al., 2020). A growing body of recent studies investigating the psychological impact of Covid-19 have reported an increase in depressive and anxiety symptoms, as well as an impaired sleep quality in the general population compared to pre-pandemic times (Vindegaard and Benros, 2020). These findings are concerning, as mental illnesses explain 4.9% of overall disability-adjusted life years (DALYS, Global Burden of Disease Collaborative Network, 2019). Apart from the fear of infection, this increase of mental distress may be attributed to financial hardship (Rajani et al., 2016; Richardson et al., 2017), job insecurity (Kim et al., 2019) and unemployment (Stauder, 2019; Theodossiou, 1998) due to the economic consequences of the pandemic. In addition, short-time work, working remotely and the ban of social gatherings might have

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led to isolation, loss of social support, daily structure, and positive reinforcement (Paul et al., 2009; Santini et al., 2020).

Due to the restrictions on social gatherings and temporary closing of sports facilities, also exercising became increasingly difficult for the majority of the population. Indeed, first evidence suggested a global reduction in exercise training during the lockdown (Mattioli et al., 2020; Meyer et al., 2020; Schuch et al., 2021). This is of special concern, as physical activity (PA) and regular aerobic exercise are known to be potential protective factors for mental health (Holmes et al., 2020). In fact, pre-pandemic evidence shows convincing prevention and intervention effects of PA for depression, anxiety and sleeping disorders (Ashdown-Franks et al., 2020; Banno et al., 2018; Schuch et al., 2019; Schuch et al., 2018; Sporndly-Nees et al., 2017). Physical inactivity and a decrease in PA are also most likely associated with higher symptoms of depression and anxiety during COVID-19-induced social distancing measures (Wolf et al., 2021).

PA is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. Exercise is planned, structured physical activity with the objective of improving or maintaining physical fitness (Caspersen et al., 1985). Recent studies suggested that engaging in exercise training might be even more effective than simply being physically active: According to a recent systematic review, only two of seven studies reported a positive association between switching to an active commute to the workplace and a reduction of depressive symptoms (Marques et al., 2020). In comparison, aerobic exercise that focuses on cardiovascular fitness has large positive effects on mental health. The same holds for exercise programs (e.g., aerobic, running, swimming, jogging, walking, or bicycling) with the particular intention of reducing depressive symptoms (Morres et al., 2019).

Sudeck and Pfeifer (Carl et al., 2020; Sudeck and Pfeifer, 2016) proposed the model of physical activity-related health competence (PAHCO), which assumes that not only the quantity and intensity of exercise, but also PA-specific skills, such as affect regulation, are important to cope with the demands that arise during the initiation and maintenance of mental health-enhancing exercise training. Especially in challenging times as in a pandemic, knowledge about the positive effects of exercise on mental health and the competence to plan exercise accordingly might increase the benefits of exercise. Indeed, Sudeck et al. (2018) showed that individuals who engage in exercise with the scope and the skill to regulate their (negative) affective states show greater benefits in affective well-being.

In this unprecedented pandemic it is of utmost importance to shed light on the psychological distress and to give directions for appropriate management strategies and novel interventions to mitigate the mental burden. In this cross-sectional survey, we examined the impact of the he COVID-19 pandemic during the acute lockdown period on prevalence rates of depressive symptoms, generalized anxiety and insomnia in the general German adult population. The primary objective of this study was to assess whether exercise behavior during the lockdown was associated with depressive symptomology, as well as with generalized anxiety symptoms and sleep quality (both secondary aims) while controlling for other potential risk and protective factors. We expected an association of an active exercise engagement with less pronounced symptoms of mental distress. We also hypothesized that the knowledge and skill to engage in exercise with the goal of affect regulation positively enhances the effect of exercise on the alleviation of the symptoms of mental disorders.

2. Materials and methods

2.1. Study design

The current study is part of a larger longitudinal online survey with four measurement time points (T1, T2, T3, T4). Data for the first measurement point (T1) was collected in the early phase of the pandemic during the first (partial) lockdown period in Germany (April 8th, 2020 - April 26th, 2020) with Covid-19-related restrictions of public life. The second wave of data collection (T2) took place as confinement regulations were eased again in springtime (May 22nd, 2020 – May 29th, 2020). Data for the third measurement point (T3) was collected after the new Covid-19 variant Omicron had emerged (January 11th, 2022 – January 18th, 2022). The last measurement point (T4) will be scheduled once all restrictions are lifted.

This report focuses on the data of the first measurement point (T1), resulting in a cross-sectional design. The study was approved by the local ethics committee for research at the Faculty of Economics and Social Sciences and registered on the German Clinical Trial Register (DRKS00021791).

2.2. Sample recruitment and inclusion criteria

Recruiting was performed online via multiple channels. (a) Social media: The survey was promoted in a German podcast (Banse and Buermeyer, 2020) and communicated through social media such as Spotify and Instagram; (b) Mailing lists: Chambers of Commerce and Industry, gastronomy associations, ministries, diaconia, sports associations and universities. Regional companies and schools published the study in their intranet. (c) Website articles: Several associations informed their networks through website articles (University of Tuebingen, German Track and Field Association, Deutsche Depressionsliga e.V. (German Depression League)).

Eligible participants included all adults aged 18 and older with sufficient German language proficiency.

2.3. Survey procedure

The anonymous survey was conducted using the online survey software SoSci Survey (Leiner, 2016). Participants provided informed consent electronically prior to responding to a set of questionnaires with self-developed and previously validated psychometric instruments (see *Measures* section). The online survey had officially been launched on April 8, 2020, the time for completion was estimated with 15-25 minutes. After completion of the survey, participants were provided with contact numbers of phone-based counselling concerning psychological burden and domestic abuse. Participants who were interested in participating in T2 and T3 of the study provided their e-mail address. All questionnaires (see Appendix A) used a self-report format.

2.4. Measures

2.4.1. Mental health: primary (depression) and secondary outcomes (anxiety, sleep quality)

Patient Health Questionnaire (PHQ-D). The German Patient Health Questionnaire PHQ-D (Löwe et al., 2002) consists of several modules addressing somatoform disorders, depression, panic disorders and generalized anxiety symptoms, as well as eating disorders and alcohol abuse. In our study, the primary endpoint *depressive symptoms* was measured with the PHQ-9 module, assessing symptoms over the last two weeks with 9 items, each of them representing one of the DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, 4th Edition) criteria for a depressive episode. All items are rated on a 4-point Likert scale (range: 0-3). The sum of all items represents the total score (range: 0-27). Higher scores indicate higher levels of depression. It has to be noted that the PHQ-9 does not provide a confirmed clinical diagnosis of a depressive disorder, but has been validated against structured interviews, such as the Structured Clinical Interview for DSM-IV (SCID), which are considered the diagnostic gold standard (Kroenke et al., 2001). In medical settings the cut-off of $\geq$10 is used to screen for a major depressive disorder. This cut-off was shown to have a sensitivity and specificity of 0.88 and 0.85, respectively (Levis et al., 2019). The scale measuring depressive symptoms has an internal consistency of Cronbach's α=.88 (Gräfe et al., 2004). In our study the scale for depressive

symptoms revealed an internal consistency of Cronbach's α = .86.

Other anxiety symptoms (generalized anxiety disorders, not specified anxiety disorders) were assessed using module 5 of the German version PHQ-D, a 7-item scale consisting of a general question on the frequency of nervousness, tension, and excessive worries and six questions on further anxiety symptoms within the last four weeks. Each item is scored on a 3-point Likert-type scale (range: 0-2). Higher scores indicate higher severity. A generalized anxiety disorder (PHQ-AD) is indicated if the first question *(*Question 1*: Feeling nervous, anxious or on edge?)* together with at least three other anxiety symptoms are rated with the highest severity level.

Pittsburgh Sleep Quality Index (PSQI). With 19 items the PSQI (Buysse et al., 1989) assesses the self-reported *sleep quality* within the last four weeks using a global score consisting of the components sleep duration, sleep disturbance, sleep latency, daytime dysfunction, sleep efficiency, overall sleep quality and sleep medication use. Each component ranges from zero (*not during the last four weeks*) to three (*three or more times a week*). The global score consists of the summation of all seven components and ranges from 0 to 21. Higher scores indicate lower sleep quality. Individuals are classified as not fulfilling symptoms of sleeping disorders (global score 0-5) and fulfilling symptoms of sleeping disorders (score 6-21). Previous studies reported a reliability of Cronbach's α = .77 for the total score (Doi et al., 2001). In this study the total score revealed an internal consistency of Cronbach's α = .74 (refer to Supplement 1 for a list of internal consistency values for all scales).

2.4.2. Exercise-related factors

BSA-Questionnaire. The Physical Activity, Exercise, and Sport Questionnaire (Bewegungs- und Sportaktivitätsfragebogen (BSA-F), Fuchs et al., 2015) examines PA in employment, commuting, chores, leisure time and exercise activity over the past four weeks with 15 items. As we were primarily interested in planned physical exercise with the purpose of maintaining physical fitness, we decided to only include exercise activity in the analyses. Participants were asked if they had engaged in exercise training within the last four weeks. To quantify their exercise training, they could furthermore indicate the frequency (days/last four weeks) and duration (minutes) of three different kind of exercise and sport activities. The total duration of exercise activity was calculated and expressed in minutes per week (min/week; Fuchs et al., 2015).

Change in Exercise. Change in exercise was assessed by one item. Participants indicated their changes in their exercise activity compared to before the COVID-19 pandemic, ranging from *less active* to *more active* on a 7-point Likert-type scale. Participants were categorized into being less active (1-3), just as active (4) and more active than before the pandemic (5-7).

PA-related Health Competence Questionnaire (PAHCO). The PAHCO model assumes three interrelated sub-competencies essential for exercise training to have beneficial effects (Sudeck and Pfeifer, 2016). We used the *affect regulation* subscale of the PAHCO to examine PA-related affect regulation with four items on a 4-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (4). The mean of the four items represents the overall score (range: [1; 4]). The reliability of this scale was determined by Sudeck and Pfeifer (2016) with Cronbach's α ranging from α = .88 to .89. In this study the subscale PA-related affect regulation revealed an internal consistency of Cronbach's α = .91.

2.4.3. Covariates: socio-demographics and Covid-19-related lifestyle consequences

Covid-19 questionnaire. Socio-demographic and Covid-19-related questions were self-designed by our research team and included questions on age, gender, education, employment status, relationship status, number of persons in their household and number of children.

Participants also reported their current everyday life situation during the lockdown. Information on their health status (i.e., infection with Covid-19, chronic illness), daily structure before and during the COVID-19 pandemic, number of social interactions before/during the COVID-19 pandemic, satisfaction with social life and changes in employment and working situation (working from home) were collected. Furthermore, participants were asked to state whether they were affected by layoff threats or had worries about their financial and supply situation (e.g., food, medicine). All items except health status were rated on a visual analogue scale (VAS), range 0-100. High scores indicate high levels of the respective item.

Perceived Social Support Questionnaire (F-SozU). The Perceived Social Support Questionnaire (Fragebogen zur Sozialen Unterstützung (F-SozU), Fydrich et al., 2009) assesses subjectively perceived and anticipated support from the social environment. The short version consists of 14 items rated on a 5-point Likert-type scale. The mean of all items represents the total score, higher scores indicate a higher perceived social support (range: [1; 5]). The questionnaire shows an internal consistency of Cronbach's α = 0.94 (Fydrich et al., 2009). In this study the questionnaire revealed an internal consistency of Cronbach's α = .93.

2.5. Data processing and statistical analysis

Descriptive statistics, including frequencies (*n*) and percentages (%), were generated for categorical variables; means and standard deviations (*SD*) or median and interquartile range (*IQR*) were generated for continuous variables as appropriate according to the distribution. To compare study population characteristics grouped by the definition of a depressive disorder (cut-off score PHQ-9 ≥ 10), a bivariate analysis was performed using Student's t-test for normally distributed variables, Mann-Whitney-U test for non-normal distributions and Chi-square test for categorical data.

To deal with missingness, multiple imputation (MI) by chained equations (MICE) was applied using the R package *mice* 2.9 (van Buuren and Groothuis-Oudshoorn, 2011). The number of imputations was set to *m*=30. For details of the MI procedure, please refer to Supplement 2. Results are presented after pooling by Rubin's rules (Rubin, 1987). We performed a sensitivity analysis with complete cases (CC) for the main outcome excluding patients with missing data (Supplement 3).

For our primary dependent variable, depression (***Model 1***), and our secondary outcomes, generalized anxiety symptoms (***Model 2***) and sleep quality (***Model 3***), separate multiple linear regression models were conducted to establish the associations between the consequences of the confinement and depression symptoms. Independent variables were exercise duration, change in exercise, and PA-related affect regulation. Further covariates included age, gender, relationship status, suffering from a chronic disease, change in employment situation, being threatened by a work-related event (short-time work, job loss/insolvency), financial worries, worries about the supply situation, satisfaction with social life, social support, and daily structure. Variable selection was performed manually as well as with stepwise selection. As we were especially interested in the interaction between exercise and PA-related affect regulation, this interaction was tested for significance in all three models. Mean-centering was applied. In case of a significant interaction effect, the interaction was probed by testing the conditional effects of the independent variable at levels of the potential moderator. As a supplementary analysis we repeated the analysis with the dichotomous outcome measure as dependent variable for the corresponding mental disorder of the main outcome (depressive disorder (yes/no)) using a logistic regression model (see Supplement 4).

Assumptions of normality of the residuals, linearity, homoscedasticity and multicollinearity were assessed by graphical means and appropriate measures. To assure normality of the residuals, the following independent variables had to be log-transformed: Change in employment situation, financial worries, worries about supply situation, satisfaction with social life and daily structure. Due to the strongly skewed distribution of exercise (min/week) with a large number of

Table 1
Socio-demographics, exercise behavior and Covid-19-related lockdown consequences for the total study population and stratified by PHQ-9 depression cut-off.

	Total	By PHQ-9 depression cut-off*		
	n=4253	PHQ-9<10 (negative) n=2925	PHQ-9≥10 (positive) n=1326	*p*
SOCIO-DEMOGRAPHICS				
Gender				<.001[$]
Female	3352 (78.8%)	2228 (76.2%)	1122 (84.6%)	
Male	900 (21.2%)	696 (23.8%)	204 (15.4%)	
Missing (*n; %*)	1 (~0%)	1 (~0%)	0 (0%)	
Age (years)				
18-24	1050 (24.7%)	608 (20.8%)	441 (33.3%)	
25-44	2398 (56.4%)	1675 (57.3%)	722 (54.4%)	
44-64	714 (16.8%)	567 (19.4%)	147 (11.1%)	
65+	89 (2.1%)	74 (0.25%)	15 (0.11%)	
Mean (*SD*)	33.65 (12.18)	34.93 (12.49)	30.85 (10.96)	<.001[t]
Missing (*n; %*)	2 (~0%)	1 (~0%)	1 (~0%)	
Relationship status[a]				<.001[$]
Single	1575 (36.9%)	964 (33.0%)	603 (45.5%)	
In a relationship	2692 (63.1%)	1961 (67.0%)	722 (54.4%)	
Missing (*n; %*)	1 (~0%)	0 (0%)	1 (~0%)	
Education				<.001[$]
Secondary school or below	296 (7.0%)	186 (6.4%)	110 (8.3%)	
High school	1048 (24.7%)	628 (21.5%)	420 (31.7%)	
Vocational training or bachelor	1379 (32.4%)	951 (32.5%)	426 (32.1%)	
Master or above	1528 (35.9%)	1158 (39.6%)	370 (27.9%)	
Missing (*n; %*)	2 (~0%)	2 (~0%)	0 (0%)	
Work status				<.001[$]
Job/student/apprentice	3693 (86.9%)	2600 (89.0%)	1093 (82.5%)	
Not working	554 (13.0%)	321 (11.0%)	232 (17.5%)	
Missing (*n; %*)	6 (0.1%)	4 (0.1%)	1 (~0%)	
EXERCISE BEHAVIOR				
Exercise training during last 4 weeks				<.001[$]
Yes	2794 (65.9%)	2094 (71.9%)	698 (52.7%)	
Missing (*n; %*)	16 (0.3%)	14 (%)	2 (0.2%)	
Amount of exercise [b] (min/week)				
[0; 75]	1759 (41.5%)	1027 (35.5%)	731 (55.2%)	
(75; 300]	1582 (37.3%)	1188 (40.8%)	394 (29.8%)	
> 300	896 (21.1%)	696 (23.9%)	199 (15.0%)	
Median (*IQR*)	120 (272.5)	150 (300)	45 (210)	<.001[&]
Missing (*n; %*)	16 (0.3%)	14 (0.5%)	2 (0.2%)	
Change in exercise extent				<.001[$]
Diminished	1440 (33.9%)	877 (30.0%)	563 (42.5%)	
No change	1195 (28.1%)	865 (29.6%)	329 (24.8%)	
Increased	1615 (38.0%)	1181 (40.4%)	433 (32.7%)	
Missing (*n; %*)	3 (~0%)	2 (~0%)	1 (~0%)	
PA-related affect regulation (PAHCO) (1-4)				<.001[&]
Median (*IQR*)	3 (1.25)	3.25 (1.25)	2.75 (1.5)	
Missing (*n; %*)	7 (~0%)	7 (~0%)	0 (0%)	
COVID-19-RELATED COVARIATES				
		Health status		
Chronic disease				
Yes	383 (9.0%)	152 (5.2%)	231 (17.4%)	
Missing (*n; %*)	1 (~0%)	0 (0%)	1 (~0%)	
Covid-19 diagnosis *(within the last 4 weeks)*				0.99[$]
Yes	15 (0.4%)	8 (0.3%)	7 (0.5%)	
Missing (*n; %*)	1 (~0%)	0 (0%)	0 (0%)	
		Lifestyle consequences		
Social contacts				0.99[$]
Diminished	3988 (95.2%)	2739 (95.1%)	1247 (95.5%)	
No change	72 (1.7%)	51 (1.8%)	21 (1.6%)	
Increased	127 (3.0%)	89 (3.1%)	38 (2.9%)	
Missing (*n; %*)	66 (1.5%)	46 (1.6%)	20 (1.5%)	
Satisfaction with social life (VAS; 0=not satisfied,100=very satisfied)				<.001[&]
Median (*IQR*)	43.0 (51)	50.0 (50)	24 (41)	
Missing (*n; %*)	43 (1.0%)	13 (0.4%)	30 (2.3%)	
Perceived social support (1-5)				<.001[&]
Median (*IQR*)	4.57 (0.86)	4.64 (0.59)	4.21 (1.14)	
Missing (*n; %*)	6 (~0%)	5 (0.1%)	1 (~0%)	
Daily structure				<.001[$]
Less structured	3044 (71.7%)	1980 (67.7%)	1063 (80.3%)	
No change	437 (10.3%)	367 (12.6%)	190 (5.3%)	
More structure	767 (18.1%)	576 (19.7%)	1323 (14.4%)	
Missing (*n; %*)	5 (0.1%)	2 (~0%)	3 (0.2%)	
Change in employment situation [c] (VAS; 0=no change, 100=very changed)				
Median (*IQR*)	60 (68)	52 (66.0)	72 (66.25)	<.001[&]
Missing (*n; %*)	45 (1.0%)	32 (1.1%)	13 (0.9%)	
		Worries and threats		

(*continued on next page*)

Table 1 (*continued*)

	Total	By PHQ-9 depression cut-off*		
	n=4253	PHQ-9<10 (negative) n=2925	PHQ-9≥10 (positive) n=1326	*p*
Short-time work, job loss, insolvency				<.001$
Short-time work	709 (16.7%)	510 (17.0%)	199 (15.0%)	
Layoff/Insolvency	345 (8.1%)	172 (5.0%)	173 (13.0%)	
No	3195 (75.2%)	2239 (76.7%)	954 (71.9%)	
Missing (*n; %*)	4 (~0%)	4 (0.1%)	0 (0%)	
Financial worries (VAS; 0=no worries,100=very worried)				
Median (*IQR*)	13 (40)	10 (29)	23 (57)	<.001&
Missing (*n; %*)	142 (3.3%)	108 (3.7%)	34 (2.6%)	
Worries about supply situation (VAS; 0=no worries,100=very worried)				
Median (*IQR*)	7 (17)	6 (15)	9 (22)	<.001&
Missing (*n; %*)	169 (4.0%)	127 (4.3%)	42 (3.2%)	

*for n=2 patients the PHQ-9 score could not be computed due to missing data. However, they will be included in the analysis after MI.
a in a steady relationship (married, unmarried couple) or not (single, divorced, widowed)
b self-reported sports activities
c subgroup of working participants
VAS = visual analogue scale 0-100
$ Chi-squared; t Student's T-test; & Mann-Whitney; p-values were Bonferroni-adjusted for multiple testing.

Table 2
Prevalence of symptoms of mental disorders.

	Sample of the present study during COVID-19 lockdown			Reported prevalence in the general population before COVID-19		
	Male (m) (n)%	**Female (f) (n)%**	**Total (t) (n)%**	**m %**	**f %**	**t %**
Depressive disorder (PHQ-9 ≥ 10) (n=4250)	204 (22.7%)	1122 (33.5%)	1326 (31.2%)	6.1%[a]	10.2%[a]	8.1%[a]
Generalized anxiety disorder (PHQ-AD[$]) (n=4252)	30 (3.3%)	287 (8.6%)	317 (7.5%)	1.5%[b]	2.9%[b]	2.2%[b]
Insomnia (PSQI global score ≥ 6) (n=4153)	314 (35.7%)	1471 (44.9%)	1785 (43.0%)	28.7%[c]	42.5%[c]	35.9%[c]

*Lower scores denote better mental health outcomes.
[a] (Busch et al., 2013). [b] (Jacobi et al., 2014). [c] (Hinz et al., 2017). [$]Conditions for a generalized anxiety disorder are described in the Methods section.

Table 3
Multiple regression for depression symptoms (PHQ-9) (**Model 1**).

Predictor	*B*	*SE*	β	*t*	*p*
Socio-demographics					
Gender					
Male	*ref*				
Female	1.365	0.154	0.107	8.857	**<.001**
Age (years)	-0.066	0.005	-0.154	-12.006	**<.001**
Relationship status					
In a relationship	*ref*				
Single	0.294	0.132	0.027	2.234	**.025**
Exercise behavior					
Change in Exercise					
No change	*ref*				
Less exercise	0.849	0.161	0.077	5.269	**<.001**
More exercise	0.222	0.161	0.021	1.376	.169
PA-related affect regulation (PAHCO)[$]	-0.148	0.127	-0.024	-1.161	.246
Exercise training yes	-0.429	0.164	-0.034	-2.626	**.008**
Exercise training yes * PA-related affect regulation	-0.651	0.168	-0.071	-3.872	**<.001**
Covid-19-related covariates					
Chronic disease present	2.409	0.223	0.132	10.826	**<.001**
Financial Worries (VAS)*	0.366	0.048	0.106	7.653	**<.001**
Worries supply situation (VAS)*	0.230	0.049	0.060	4.650	**<.001**
Negative job event threat					
None	*ref*				
Short-term work	-0.395	0.177	-0.028	-2.231	**.026**
Job loss/insolvency	0.880	0.240	0.046	3.664	**<.001**
Change in employment situation (VAS)*	0.089	0.049	0.023	1.801	.072
Satisfaction with social life (VAS)*	-0.865	0.049	-0.185	-14.646	**<.001**
Daily Structure (VAS)*	-1.583	0.083	-0.248	-19.080	**<.001**
Social support (VAS)	-1.627	0.097	-0.216	-16.792	**<.001**

B pooled unstandardized regression coefficient, β pooled standardized beta; *log-transformed
F pooled (29, 8913.75) = 178.67; *p* =<.001; R^2*-adjusted pooled* 0.419.
[$] centered; VAS = visual analogue scale.

respondents not engaging in any exercise training (0 minutes), we had to dichotomize this variable into the groups *active (exercise training yes)* and *inactive*. Exploratively, we considered a model with the continuous variable exercise (min/week) with the subgroup of participants engaging in at least some exercise training (>0 min).

Data preparation and statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS, version 26, IBM Corp., Armonk, N.Y., USA), the statistical analysis software R (version 3.63 and 4.03) and RStudio (version 1.3.1056). All p-values were two-sided, the statistical significance level was set at $p < .05$ and adjusted for multiple testing with Bonferroni correction where necessary.

3. Results

3.1. Study population

4,343 respondents completed the questionnaire. 71 participants were excluded as they did not fulfil the inclusion criteria of being 18 years and older. One respondent specified an implausible high age, three participants were excluded because of insufficient data quality. Fifteen respondents indicated the gender 'diverse'. Due to the low number, we did not include these participants into our analysis, as reliable results for this group could not be provided. This left a total of 4,253 participants as study sample (see Flowchart in Supplement 5). For percentages of overall missingness and missing data in the relevant variables please refer to Supplement 3.

3.2. Sample characteristics

Socio-demographic information, health status, consequences and worries due to Covid-19 confinements of the total study population and stratified by PHQ-9 cut-off score are displayed in Table 1.

The sample was predominantly composed of females (78.8%) and younger (*mean*=33.65, *SD*=12.18) well-educated persons (35.9% master's degree and above). Almost two-thirds of the respondents (n=2794, 65.9%) had engaged in exercise training within the last four weeks, 1,440 (33.9%) indicated that they had diminished their extent of training during the lockdown, 1,195 (28.1%) reported no change in exercise behavior, whereas 1,615 (38%) increased their exercise training. The median duration of exercise training per week was 120 minutes (*IQR*=272.5) including those respondents who did not engage in exercise training at all.

3.3. Prevalences of symptoms of depression, generalized anxiety and insomnia

Table 2 provides an overview of the mental health outcome scores and prevalence of mental disorders in the present study sample compared to pre-pandemic prevalence in the general population of Germany. Depression scores (PHQ-9) ranged from 0 to 27 (*mean* = 7.9, *SD* = 5.2). The overall prevalence of a depressive disorder (PHQ-9≥10) in our sample was 31.2% (95%-CI: 29.8 – 32.6), 22.7% among men (95%-CI: 20.0 – 25.5) and 33.5% (95%-CI: 31.9 – 35.1) among women. This indicates a prevalence that is three to four times as high as the prevalence of depressive disorders diagnosed using the PHQ-9 in German adults in 2013, which was specified with 8.1% (Busch et al., 2013). Generalized anxiety symptom scores ranged from 0 to 8 (*mean* 1.7, *SD*=1.9). In 2014, 2.2% of the German population fulfilled symptoms of a generalized anxiety disorder. In our sample, 7.5% (n=317; 95%-CI: 6.7% - 8.2%) were affected by a generalized anxiety disorder, 8.6% (n=287; 95%-CI: 7.6% - 9.5%) among women and 3.3% (n=30; 95%-CI: 7.6% - 9.5%) among men. Furthermore, 43.0% (n=1785; 95%-CI: 41.5% - 44.5%) of the respondents reported symptoms of insomnia (PSQI total score ≥ 6). This is a much higher prevalence than in 2016, when only 35.9% of the German population reported symptoms of insomnia (PSQI total score > 5, Hinz et al., 2017). The PSQI global score ranged from 0 to 20 with a mean value of 5.7 (*SD*=3.2).

3.4. Multiple regression analyses

Multiple regression results for our main outcome, the PHQ-9 score of depressive symptoms (*Model 1*) are reported in Table 3 (pooled estimates over the MI sets; see Supplement 3 for a sensitivity analysis with complete cases), the regression models for our secondary outcomes generalized anxiety (*Model 2*) and sleep quality (*Model 3*) are provided in Table 5. Several of the demographic and Covid-19 related covariates were consistently related to the mental health outcomes across the three models. Being female, having a chronic disease, financial worries and worries about the supply situation were significantly associated with higher depression, anxiety and insomnia levels. Conversely, a higher satisfaction with social life, more daily structure and better social support were significantly associated with lower levels of mental distress. For further details on the covariates, please refer to the respective tables.

3.4.1. Primary endpoint: exercise and depression (Model 1)

The total variability accounted for by the model was 41.9% (F_{pooled} (29, 8913.75) = 178.67; p=<.001; *adjusted* R^2_{pooled} = 0.419). A change in

Table 4
Simple effects analysis for exercise status and PA-related affect regulation **(Model 1-3).**

PA-related affect regulation	Exercise status				Simple effects (differences)		
	Inactive		Active				
	Mean (95% CI)	*SE*	*Mean (95% CI)*	*SE*	*Estimate (SE)*	*t*	*p*
Model 1: Depressive Symptoms (PHQ-9)							
One SD below mean	8.93 (8.59; 9.27)	0.175	8.66 (8.33; 8.98)	0.165	0.274 (0.160)	1.709	.087
At the mean	8.90 (8.54; 9.26)	0.184	8.47 (8.16; 8.78)	0.158	0.427 (0.163)	2.617	.009
One SD above mean	8.87 (8.48; 9.25)	0.197	8.29 (7.98; 8.59)	0.156	0.580 (0.175)	3.321	.001
Model 2: Generalized Anxiety Symptoms (PHQ-AS)							
One SD below mean	1.93 (1.79; 2.08)	0.074	1.82 (1.69; 1.96)	0.070	0.106 (0.065)	1.643	.100
At the mean	1.93 (1.77; 2.08)	0.078	1.79 (1.65; 1.91)	0.067	0.142 (0.066)	2.141	.032
One SD above mean	1.93 (1.76; 2.09)	0.083	1.74 (1.62; 1.88)	0.066	0.178 (0.071)	2.492	.013
Model 3: Sleep quality (PSQI)							
One SD below mean	6.34 (6.12; 6.57)	0.116	6.08 (5.87; 6.29)	0.108	0.265 (0.112)	2.429	.015
At the mean	6.32 (6.08; 6.56)	0.123	5.99 (5.79; 6.19)	0.103	0.327 (0.114)	2.880	.004
One SD above mean	6.30 (6.04; 6.56)	0.132	5.91 (5.71; 6.11)	0.102	0.388 (0.122)	3.151	.002

Results are averaged over the levels of the other factors in the model.
Bold=significant. Values are pooled results over MI sets.

Table 5
Multiple regression for generalized anxiety (PHQ-AS) and sleep quality (PSQI global score) **(Model 2 & Model 3).**

Variables	Model 2: Generalized Anxiety				Model 3: Sleep quality			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Socio-demographics								
Gender								
Male	*ref*				*ref*			
Female	0.657	0.063	0.141	**<.001**	0.733	0.107	0.094	**<.001**
Age (years)	-0.009	0.002	-0.060	**<.001**	0.009	0.004	0.036	**.022**
Relationship status	-	-	-	-				
In a relationship					*ref*			
Single					0.380	0.093	0.058	**<.001**
Education								
Master or above	*ref*				*ref*			
Vocational training or bachelor	-0.187	0.063	-0.046	**.003**	0.158	0.108	0.023	.144
High school	0.004	0.071	0.001	.713	0.178	0.181	0.024	.147
Secondary school or below	-0.038	0.105	-0.005	.948	0.625	0.122	0.050	**<.001**
Exercise behavior								
Change in Exercise								
No change	*ref*				*ref*			
Less exercise	0.223	0.065	0.055	**<.001**	0.390	0.113	0.058	**<.001**
More exercise	0.065	0.065	0.016	.321	0.032	0.113	0.005	.778
PA-related affect regulation (PAHCO)[$]	-0.011	0.052	-0.005	.836	-0.103	0.089	-0.027	.246
Exercise training yes	-0.142	0.066	-0.035	**.003**	-0.327	0.114	-0.049	**.004**
Exercise training yes * affect regulation	-0.157	0.068	-0.047	**.002**	-0.266	0.118	-0.047	**.024**
Covid-19-related covariates								
Chronic disease present	0.987	0.091	0.148	**<.001**	1.570	0.157	0.141	**<.001**
Financial Worries (VAS)*	0.011	0.001	0.162	**<.001**	0.015	0.002	0.131	**<.001**
Worries supply situation (VAS)*	0.008	0.001	0.083	**<.001**	0.008	0.002	0.053	**<.001**
Negative job event threat					-	-	-	-
None	*ref*							
Short-term work	-0.091	0.071	-0.018	.203				
Job loss/insolvency	0.185	0.099	0.026	.061				
Satisfaction with social life (VAS)*	-0.287	0.025	-0.168	**<.001**	-0.352	0.041	-0.124	**<.001**
Daily Structure (VAS)*	-0.376	0.034	-0.162	**<.001**	-0.517	0.058	-0.133	**<.001**
Social support (VAS)	-0.349	0.039	-0.127	**<.001**	-0.672	0.068	-0.146	**<.001**

B pooled unstandardized regression coefficient, β pooled standardized beta; *log-transformed.
Generalized Anxiety: *F pooled* (29, 96745.99) = 86.259; *p* =<.001; R^2-*adjusted pooled* 0. 278.
Sleep quality: *F pooled* (29, 26482.35) = 76.066; *p* =<.001; R^2-*adjusted pooled* 0.233.
[$] centered; VAS = visual analogue scale.

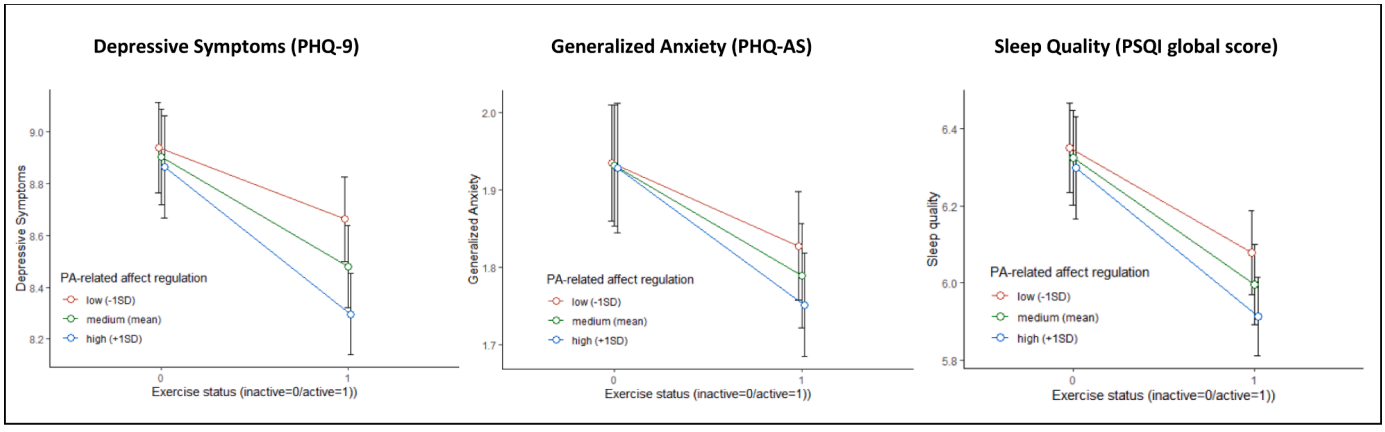

Fig. 1. Post-hoc probing of moderation effect of PA-related affect regulation on the relationship between exercise status and mental health outcomes. SD = standard deviation; PA = physical activity; PHQ = Patient Health Questionnaire; PSQI = Pittsburgh Sleep Quality Index.

exercise towards less exercise was significantly associated with higher levels of depression (*t*=5.269; β = 0.077; *p*<.001), whereas a change towards more exercise was not significantly related to depressive symptoms. The main effect of exercise status (*active*) was found to be significantly negatively associated with depressive symptoms (*t*=-2.626; β =-0.034; *p*=.008), PA-related affect regulation did not reach significance. However, these main effects are qualified by the interaction between exercise status and PA-related affect regulation, which yielded significance (*p*<.001). To describe the direction of the significant interaction effect between exercise status (*inactive/active*) and PA-related affect regulation, post-hoc probing of the moderating effects was applied (Table 4).

At higher values of PA-related affect regulation, the difference between being inactive and active with respect to depressive symptoms becomes more pronounced (see Fig. 1). Testing the pairwise differences (see simple effects), we found differences to be significant at the mean and +1*SD* of PA-related affect regulation.

Exploratively, we analyzed the subgroup of only active respondents, introducing the continuous variable of exercise (min/week) into Model 1 (see Supplement 6a+b). The interaction *exercise* x *PA-related affect*

regulation did not reach significance (p=.699) and simple slope analysis exhibited a similar negative relationship between exercise volume (min/week) and depression for all levels (-1*SD*=low, mean, +1*SD*=high) of PA-related affect regulation (β_{PAlow} = -0.20 (95%CI: -0.39; -0.01), β_{PAmean}= -0.19 (95%CI: -0.38;-0.01), β_{PAhigh}= -0.19 (95%CI: -0.38; -0.01)), suggesting that PA-related affect regulation is a moderator for the relationship between exercise status (inactive/active) and depressive symptoms, yet cannot amplify this effect with regard to volume of exercise training.

3.5. Secondary endpoints: exercise and anxiety/sleep quality

The anxiety model accounted for 27.8% of the variability (F_{pooled} (29, 96745.99) = 86.259; p=<.001; *adjusted* R^{2}_{pooled} = 0.278), the sleep quality model explained 23.3% of the variability (F^{pooled} (29, 26482.35) = 76.066; p =<.001; *adjusted* R^{2}_{pooled} = 0.233). Consistent with the results for the depression model, a change in exercise towards less exercise was significantly associated with higher levels of anxiety (t=3.397; β = 0.055; p<.001) and insomnia (t=3.466; β = 0.058; p<.001), whereas a change towards more exercise was not significantly related to neither anxiety nor a poor sleep quality. The main effect of exercise status (*active*) was found to be significantly negatively associated with anxiety symptoms (t=-2.127; β=-0.035; p=.003) and insomnia (t=2.854; β=-0.049; p=.004); PA-related affect regulation was not found to be related to neither anxiety nor insomnia. As in the primary analysis the main affects were qualified be the interaction term *exercise* x *PA-related affect regulation*, which was significant in both model 2 and model 3, yet not as pronounced as in the depression model (see Table 4 and Fig. 1).

4. Discussion

In this cross-sectional study our sample revealed elevated levels of symptoms of depression, anxiety and sleeping disorders throughout the COVID-19 confinements in comparison to prevalence rates in representative studies conducted before the pandemic. The prevalence of probable cases with a depressive disorder was found to be three to four times as high as the prevalence of depressive disorders estimated by using the PHQ-9 in German adults in 2013, which was specified with 8.1% in total, 6.1% among men and 10.2% among women (Busch et al., 2013). Also, the prevalence for probable cases with a generalized anxiety disorder (7.5%) was elevated in our sample. In 2014, merely 2.2% of the German population fulfilled symptoms of a generalized anxiety disorder (1.5% men, 2.9% women). According to the criterion for insomnia, Hinz et al. (2017) reported 35.9% of bad sleepers in a large German community sample in the year of 2015. This level was exceeded in our sample with 43% of the respondents' reporting symptoms of insomnia. Our results are in accordance with research on mental health during COVID-19 from North and South America (Callow et al., 2020; Liu et al., 2020; Meyer et al., 2020; Schuch et al., 2020; Torales et al., 2020), Asia (Cao et al., 2020; Huang and Zhao, 2020; Khan et al., 2020; Ueda et al., 2020; Wang et al., 2020), Europe (Pieh et al., 2020; Rossi et al., 2020; Silva Moreira et al., 2021) and Oceania (Stanton et al., 2020), all reporting elevated symptoms of mental disorders during COVID-19. These consistent results underline the strong impact of the pandemic on mental health.

In consideration of the observed global decline in exercise training during the social distancing measures (Fibit, 2020) and the well-documented beneficial effects of exercise as an affordable, non-invasive intervention to treat and prevent depressive symptoms, anxiety (Carek et al., 2011; Craft and Perna, 2004) and poor sleep quality (Siu et al., 2021), our main objective was to investigate associations between exercise training and mental health outcomes. We expected individuals who were able to keep their exercise routines at a stable level or even increased their exercise volume to show less symptoms of depression, anxiety and sleep problems, whereas individuals whose inactivity increased to exhibit higher levels of mental distress. We furthermore hypothesized that not only the quantity of exercise, but also specific PA-related skills, such as PA-related affect regulation, were important to achieve optimal effects on mental health.

One-third of our respondents did not engage in exercise within the last four weeks and one-third reported a reduction in their exercise extent. Despite challenges to engage in exercise activities through restricted sports facility access, it is noteworthy that over one-third of the participants reported a positive change towards more exercise. As a consequence of working from home, which most likely resulted in a more flexible daily structure, some people may have seized the opportunity to develop new exercise habits (Lesser and Nienhuis, 2020; Stanton et al., 2020). These findings are in accordance with other studies reporting mixed results in PA behavior changes during confinement (Violant-Holz et al., 2020).

In line with our hypotheses there was a significant positive association between change towards less exercise in comparison to participants with no change and symptom severity in all three outcomes (depressive symptoms, anxiety symptoms, sleeping disorder symptoms). With this result our cross-sectional survey complements recent studies indicating that a decrease in the amount of exercise is associated with higher depression levels (Deng et al., 2020; Meyer et al., 2020; Stanton et al., 2020; Wolf et al., 2021) more anxiety symptoms (Deng et al., 2020; Stanton et al., 2020) and a disturbed sleep pattern (Diniz et al., 2020).

Against our expectations, associations between a change towards more exercise and mental health were not significant. Lesser et al. (2020) have shown that there are significant differences between regularly active (>150 min of moderate-vigorous physical activity/week) and inactive persons (<149.9 min/week) with active persons having a greater motivation and external regulation to stay active or even increase their activity level in challenging times as the pandemic. Thus, one might assume that those who increased their exercise volume were individuals who generally engage in a more active lifestyle. Increasing a high level of physical activity might not provide extra beneficial effects with respect to symptom alleviation. Conversely, another hypothesis could be that those with a high psychological burden might have attempted to offset negative emotions by additional exercise, however, not achieving mitigation due to the lack of adequate PA-related skills. A recent study investigating the dose-response curve between physical activity and negative emotions has indicated that an inadequate or excessive amount of physical activity can worsen negative emotions (Zhang et al., 2020). Future longitudinal analyses will provide more insight on within-subject changes of exercise behavior over time.

Our results furthermore indicate as hypothesized that the competence for PA-related affect regulation enhances the effect of exercise training to alleviate symptoms of depression, anxiety and insomnia. In case of a low PA-related affect regulation, no significant differences in depressive and anxiety symptoms estimates could be found between respondents being active (exercise within the last four weeks) or inactive (no exercise within the last four weeks). In case of medium and high PA-related affect regulation, estimates for all three outcomes, depressive symptoms, anxiety and sleep disorder symptoms were significantly lower in the group of participants engaging in exercise. This confirms the assumption of Sudeck and Pfeifer (2016) that specific PA-related skills seem to be crucial in order to achieve optimal effects of exercise on mental health.

Considering the high prevalence of symptoms of psychiatric disorders during the pandemic and their high burden of disease, current international position papers point out a clear need to adapt and improve mental health services worldwide (Holmes et al., 2020; Moreno et al., 2020). The results of this cross-sectional study highlight the importance to develop interventions which target exercise behavior and specific skills to regulate affective states. Our findings suggest that especially the maintenance of exercise is of importance to mitigate mental health distress.

Firth and colleagues (2016) found low mood and stress to be barriers towards engaging and maintaining in regular exercise. Further specific

barriers related to the pandemic were the shutdown of sports infrastructure, the lack of time in individuals with children due to closed childcare facilities and schools (Mutz and Gerke, 2020; Nienhuis and Lesser, 2020), as well as a modified daily structure due to self-isolation and remote work from home: Prior exercise habits connected with commuting to/from the work place (e.g. visiting the sports club before/after work) or an active commute itself (e.g. cycling to work as daily training) had to be discontinued. Furthermore, due to social distancing the opportunities to exercise in a group setting was very limited. Yet, social support was found to be a specifically strong factor associated with the engagement in PA and adherence to exercise (Bauman et al., 2012; Meade et al., 2019). A supportive environment acts as a psychological resource which modulates the perceptions of the difficulty in physical challenges, enhances performance during exercise and reduces physical discomfort and fatigue (Davis and Cohen, 2018).

In order to facilitate the integration of exercise into daily life routines during the current or future pandemics, motivational and volitional skills need to be identified and encouraged (Milne et al., 2002; Zhang et al., 2019). The integration of behavioral change techniques (BCTs) into exercise programs might be an effective method to remove or work around the above-mentioned barriers and to strengthen specific affect regulation skills regarding exercise. A systematic review by Samdal et al. (2017) suggests that BCTs such as goal setting, action planning, feedback or self-monitoring are crucial in order to overcome specific barriers and maintain exercise training in daily life. To specifically strengthen affect regulations skills through exercise, especially BCTs which focus on knowledge transfer, building intentions and monitoring the changes in affective states are crucial. During the Covid-19 pandemic the knowledge about the benefits of exercising on the symptoms that accompany the lockdown measures, such as depressive symptoms, anxiety and sleeping problems, is important for an appropriate and successful coping strategy.

4.1. Limitations

Some limitations of this study have to be considered: Although recruiting was not directed to people with mental disorders, validity of the study results might be affected by a self-selection bias, which is a common problem in survey-based studies (Chen et al., 2022). The direction of the bias, however, remains unknown: People with a poor mental health might lack motivation or feel unable to complete the survey. On the other hand. individuals who suffered from mental health problems might have been more interested in participating in the survey causing the high prevalences of mental distress symptoms. Questions on previous mental disorders would have partially given insight on an overrepresentation of individuals with history of mental illnesses. To minimize this risk in advance and to ensure reaching a diverse and large portion of the population within a short time, we performed recruitment through various channels and multiple contact points in all German federal states. Nevertheless, our sample was mostly composed of females, mean age was rather low, and educational level was higher than in the general German population, also leading to limited representativeness.

Methodological limitations comprise the use of the screening tools used for the identification of depressive symptoms, anxiety, and insomnia, which are not designed to provide confirmed clinical diagnoses of mental disorders. Levis et al. (2020) have shown that the PHQ-9 substantially overestimates depression prevalence compared with prevalence based on actual diagnostic criteria. Our study therefore merely provides rough estimates than can be used as a proxy for the disorder prevalences in the population under study. However, accessible and understandable assessment instruments are still valuable tools to serve as low-cost substitutes for diagnostic instruments in situations which require a rapid screening for mental health issues. As symptom scales are most commonly used in clinical research settings and primary care (Levis et al., 2019), our results can easily be related to findings from other studies. Furthermore, it can be assumed that the predictive validity between probable versus diagnosed cases using screening measures stayed the same during the COVID-19 pandemic compared with before the pandemic (Santomauro et al., 2021). Another limitation is the reporting of crude prevalences which are displayed disaggregated by gender but were not adjusted for the specifics of the population under study. However, our study does not claim to provide epidemiological statistics, yet contributes measures to be compared with other online survey-based findings.

We further acknowledge the limitation of assessing change in exercise with only one item. To avoid recall bias, we did not assess the exercise questionnaire BSA-F with respect to pre-pandemic activity but decided to only assess change in exercise behavior on a 7-point Likert scale. In consequence we could not correlate change in exercise behavior with pre-pandemic exercise volumes. Furthermore, due to the cross-sectional nature of the study, results cannot be interpreted causally. We could detect associations, but not infer the direction of such associations. Our ongoing longitudinal study will provide more insight on changes of exercise behavior and volumes in different phases of the pandemic and the temporal relationship between exposure variables and the attenuation or aggravation of psychopathological symptoms.

5. Conclusions

To the best of our knowledge, this is the first study reporting how COVID-19-related confinements affect mental health in Germany with a special focus on PA-related affect regulation as moderator of the relationship between exercise training and depression, anxiety and sleeping quality. Our study clearly shows that the pandemic had a high impact on mental health resulting in elevated levels of symptoms for depression, anxiety and insomnia. Prolonged periods of lockdowns and curfews with limited possibilities to exercise can pose a significant challenge to remain physically active. A stable amount of exercise and specifically exercise in combination with PA-related affect regulation might yet attenuate the negative mental health consequences.

First implications from the results of the current study may involve measures that (1) promote the maintenance of exercise combined with BCTs, (2) improve PA-related affect regulation to optimize the effects of exercise on mental health. This could be put into practice through web-based tools or wearable technologies, which can easily adopt BCTs tailored to the needs of particular target groups and thus might encourage those groups to maintain their exercise routines and to overcome Covid-19 specific PA-barriers. Future research should focus on the feasibility and effectiveness of such tools. Furthermore, ongoing monitoring of the impact of the pandemic on mental health and the change of exercise behavior throughout the lockdown restrictions is needed in order to create a basis for the development of appropriate prevention and intervention methods to promote and preserve psychological well-being.

Data statement

Data is available upon reasonable request.

CRediT authorship contribution statement

Inka Roesel: Data analysis, Visualization, Manuscript writing – original draft, Writing – Reviewing and Editing. Leonie Louisa Bauer: Data collection/preparation/analysis. Britta Seiffer: Conceptualization, Data collection/preparation/analysis, Writing- Reviewing and Editing. Clara Deinhart: Data collection/preparation/analysis. Beatrice Atrott: Data collection/preparation/analysis. Gorden Sudeck: Conceptualization, Writing- Reviewing and Editing. Marting Hautzinger: Writing-Reviewing and Editing. Sebastian Wolf: Project Administration, Supervision, Conceptualization, Writing – Reviewing and editing.

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2022.114559.

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