

# Preventing Mental Health, Well-Being and Physical Activity during the Corona Pandemic – Recommendations from Psychology and Sports Medicine

*Empfehlungen für Bewegung und körperliche Aktivität zur Prävention von mentaler Gesundheit und Wohlbefinden während der Corona-Pandemie*

## Summary

- › **During the SARS-CoV-2 coronavirus pandemic**, sitting time and physical inactivity may increase worldwide across populations. Moreover, mental disorders (such as anxiety and depression), perceived stress and negative coping strategies will increase due to uncertainty (e.g., financial uncertainty, job uncertainty), actual experience of negative life events or loss of social relations (isolation from friends and families). Physical inactivity and poor mental health constitute major disease burdens in health systems.
- › **The World Health Organization (WHO)** attributes 3.2 million deaths each year to physical inactivity and sedentarism. Physical activity and regular exercise can protect mind and body against ill health. Therefore, during pandemic lockdowns, people should stay physically active and engage in regular exercise as far as possible to avoid risk of physical and mental ill health and protect well-being in the long run.
- › **In this manuscript**, we briefly review the health benefits of regular aerobic exercise with special focus on mental health and well-being. Moreover, based on scientific recommendations and empirical evidence, we provide exercise interventions to support the maintenance of low- to moderate-intensity aerobic exercise across age groups during the corona pandemic.
- › **The supervised exercise interventions** were evaluated by health professionals on exercise-related and psychological dimensions (e.g., cardiorespiratory fitness, motor skill-related fitness, age, exercise motivation, and exercise adherence) and are available in German and English.

## KEY WORDS:

Depression, Anxiety, Stress, Lockdown, Online Exercise Training, Exercise Adherence, Expert Ratings

## Zusammenfassung

- › **Während der SARS-CoV-2-Coronavirus-Pandemie** kann die körperliche Inaktivität weltweit in allen Bevölkerungsgruppen zunehmen. Auch ist zu befürchten, dass psychische Störungen (wie Angstzustände und Depression), Stresswahrnehmung und negative Bewältigungsstrategien aufgrund der notwendigen Maßnahmen der Ausgangssperren, durch Unsicherheiten am Arbeitsplatz sowie im Umgang mit negativen Lebensereignissen oder Verlust sozialer Beziehungen (Isolation) zunehmen. Körperliche Inaktivität und Einbußen in der psychischen Gesundheit zählen zu den größten Krankheitslasten von Gesundheitssystemen.
- › **Die Weltgesundheitsorganisation (WHO)** führt jährlich 3.2 Millionen Todesfälle allein auf Bewegungsmangel zurück. Regelmäßige körperliche Aktivität gilt als Schutzfaktor für die Aufrechterhaltung körperlicher und psychischer Gesundheit. Deswegen ist es wichtig, dass Menschen während der aktuellen Corona-Pandemie körperlich aktiv bleiben und soweit möglich regelmäßig Sport treiben, um ihre Gesundheit und ihr Wohlbefinden langfristig zu erhalten.
- › **In diesem Manuskript** werden die gesundheitlichen Vorteile regelmäßiger Bewegung mit besonderem Fokus auf die psychische Gesundheit und das Wohlbefinden kurz erläutert. Auf der Grundlage wissenschaftlicher Empfehlungen und empirischer Erkenntnisse werden Übungsinterventionen vorgestellt und angeboten, um regelmäßige Bewegung von Zuhause während der Corona-Pandemie zu unterstützen.
- › **Die Übungsinterventionen** wurden von Gesundheitsexperten bzgl. bewegungsbezogener und psychologischer Faktoren (kardiorespiratorische Fitness, Alter, Durchführbarkeit/Adhärenz) auf ihren Nutzen für die Erhaltung von Gesundheit beurteilt. Die Übungen werden in deutscher und englischer Sprache zur Verfügung gestellt.

## SCHLÜSSELWÖRTER:

Depression, Angstzustände, Stress, Lockdown, Online-Übungsstraining, Übungsadhärenz, Expertenbewertungen

## Problems and Objective

### Physical Inactivity: a General Health Burden and a Challenge during Pandemics

People sit for more than 3 hours up to on average of about 4.7 hours a day in more than 54 countries worldwide (27, 44, 56, 57). The World Health Organization (58) attributes 3.2 million deaths each year to physical inactivity and sedentarism. Statistically, a 50% reduction of mean sitting time could decrease mortality by 2.3% (27, 44). During the SARS-CoV-2 coron-

avirus pandemic, sitting time and physical inactivity will likely increase worldwide. This is partly caused by the obligatory governmental and medical advice of reducing job and leisure time activity to a minimum, staying at home, and avoiding social interaction as far as possible to fight an uncontrolled spreading of the virus during the pandemic crisis. Physically active people, who have been used to engage in regular exercise outdoors (e.g., in crowded city places) or

## REVIEW

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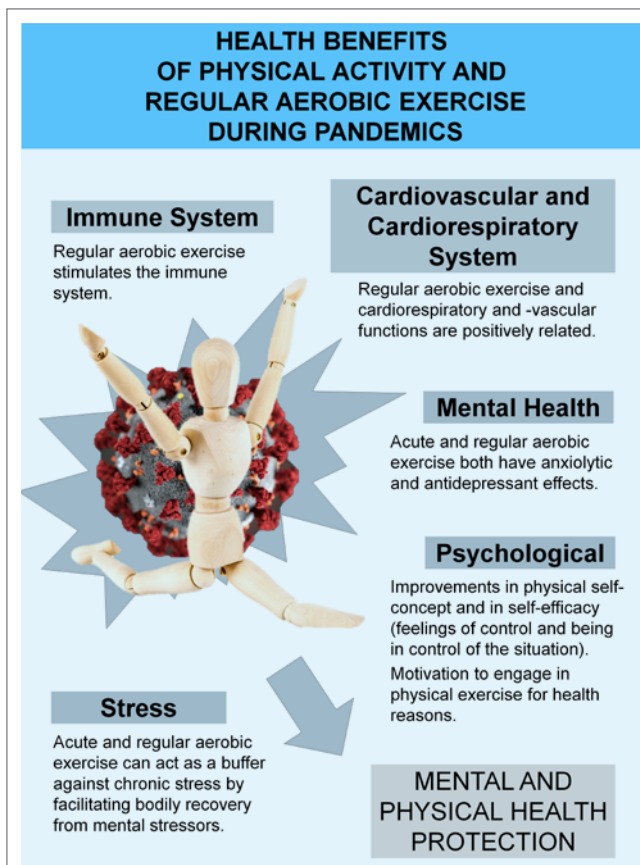


Figure 1

General and mental health benefits of physical activity and regular aerobic exercise. As described in the Introduction under a) – d), the figure provides an overview of the most well-proven health benefits of aerobic exercise with respect to the functioning of the central nervous system (CNS), the peripheral autonomous nervous system (ANS), the immune system (IS) and mental health, stress and well-being. Concerning the stimulating effects on the immune system (hormonal and cellular), regular aerobic exercise at a moderate level reduces respiratory tract infections (36). Improvements in cardiovascular functions and reduction of hypertension have been found in previously sedentary groups of people after participation in aerobic exercise interventions (25). Therefore, during the current pandemic, a strong protective effect of aerobic exercise on physical health can also be expected in people who have previously not been enrolled in regular aerobic exercise or who already accumulated health-related risk factors such as high blood pressure or overweight.

who followed regular training in fitness clubs already had to stop their exercise habits and exercise regimes of walking, jogging and sprinting, of swimming in local swimming halls, or of playing soccer, basketball, tennis or other team sports with colleagues and friends in local sport clubs (39). Likewise, sitting time and screen time may increase sedentarism (29, 39). People who did not engage in sports before the pandemic may become more physically inactive during the pandemic lockdown due to the loss of even daily physical activity routines e.g., from and to work. Although not all people across countries may be equally affected by the lockdowns and although some might not reduce their exercise (29), first big data studies and international surveys show a significant reduction in global activity in the weeks after the pandemic outbreak in the respective countries (2, 23).

Unfavorably, as known from previous pandemics that required self-isolation and quarantine (12), mental disorders such as anxiety and depression are expected to increase during pandemics as will perceived stress and negative coping

strategies due to uncertainty (e.g., financial uncertainty, job uncertainty), actual experience of negative life events (e.g., job loss), and loss of social relations due to isolation from friends and families. Scientific studies on the psychological consequences of the current SARS-CoV-2 pandemic on individual well-being and mental health in certain risk groups (e.g., Covid-19 survivors, health care professionals (11, 42)) including studies from the first corona hot spot countries have just been published (e.g., 13, 14, 39). In general, the results of these studies support a significant increase in pandemic-related mental ill health. In view of that, the WHO (59) recommended to implement health counseling programs into local and global pandemic prevention and intervention initiatives to avoid unnecessary mental health burdens in the general public (5, 59).

Poor mental health, sedentarism, and physical inactivity are among the top ten factors causing major disease burdens in Western societies and around the globe (56, 58), besides low income, unemployment, or poor education, respectively. This holds true for the general population, the elderly, and chronically ill people of all age groups (including children). A lack of physical activity and sedentarism are the major risk factors for lifestyle-related diseases including cardiovascular disease, obesity, high blood pressure (hypertension), cholesterol, or diabetes type 2 in epidemiologic studies (9). Further, lethality and mortality have been estimated of being 2 to 5 times higher in physically low-fit than physically fit people (25, 30, 37).

#### General Effects of PA and RE on Physical and Mental Health

There is full agreement across scientific disciplines: Physical activity (PA) and regular aerobic exercise (RE) are medicine. PA and RE can rescue lives by protecting mind and body against physical and mental ill health. Of major importance for exercise recommendations concerning the current SARS-CoV-2-Coronavirus pandemic is the fact, that especially aerobic exercise that involves major portions of the skeletal musculature such as running, cycling, aerobic dancing, or swimming, and that focuses on endurance and cardiorespiratory fitness has positive effects on physical and mental health. It a) stimulates the immune system (neuroimmunological and endocrine axis), b) improves cardiorespiratory functions, c) has anxiolytic and antidepressant effects, and d) acts as a buffer against chronic stress by facilitating bodily recovery and reducing perceived stress symptoms (see figure 1). The WHO (58) recommendations for health promotion regarding healthy adults suggest 150 minutes of moderate or 75 minutes of vigorous-intensity physical activity comprising aerobic exercise on 5 days a week (moderate) or on 3 days a week (vigorous).

As outlined above, physical health and mental health are not independent from each other, nor are the effects of PA and RE on physical and mental health. The effects outlined under a) – d) can occur together. They have been found in longitudinal and quasi-experimental studies investigating health benefits of aerobic exercise in clinical patient groups (with neurological, somatic or mental disorders) and they have been observed in healthy subjects without a history of chronic diseases (e.g., 6, 25, 26, 30, 38, 47, 52, 60). Thus, during the pandemic lockdown, there is an urgent need to ensure that people with and without a history of lifestyle-related diseases or mental disorders stay physically active and regularly engage in aerobic exercise as far as they can to avoid risking physical but also mental health and well-being in the long run.

## Recommendations for Mental Health, PA and Aerobic Exercise during Pandemics Depression

As far as mental health is concerned, aerobic exercise interventions have proven to successfully reduce depressive symptoms in patients with low to moderate depressive symptoms (see for an overview: 40, 50) including patients with coronary heart disease (CHD) and elevated depressive symptoms (8). The alleviating effects of aerobic exercise interventions on self-reported depressive symptoms in clinical depression have been shown to be comparable to those of antidepressant treatments (7, 20). Consequently, regular aerobic exercise has been implemented in international guidelines as one important means of secondary prevention for the treatment of mental disorders (depression) in addition to TAU (treatment as usual) (61). Furthermore, it has been recommended for primary prevention of depressive symptoms in healthy subjects (50, 51). Therefore, during the current pandemic, aerobic exercise can help to protect from an increase in depressive symptomatology in people with a diagnosis of clinical depression who already suffer from mild to moderate depressive symptoms and and it can help preventing depressive symptoms in people at risk for depression.

### Anxiety

Moreover, aerobic exercise interventions have been found to be effective in anxiety disorders (Generalized Anxiety Disorder, Panic Disorder, Obsessive-Compulsive Disorder, Social Phobia) (3), and stress-related disorders such as post-traumatic stress disorder (23, 53), i.e. disorders that are expected to increase during the current pandemic, and this not only in Covid survivors or health workers (11, 42). The spreading of the virus around the world, its exponential increase in infection probability, and its high lethality currently bear constant threats for whole societies and for each individual (59). As far as clinical anxiety symptoms are concerned, aerobic exercise interventions do not achieve the same effects as psychopharmaceutical treatment of clinical anxiety does (15), but it has proven itself as adjunctive therapeutic treatment for anxiety disorders in several randomized controlled trial studies (33). In addition, as a means of primary prevention with respect to the current pandemic, already an acute bout of aerobic exercise of moderate intensity (>21 minutes) can successfully reduce state anxiety (43). Further, a mood-regulatory effect is expected already after 7 minutes of (low to moderate) aerobic exercise.

### Stress

On a neural level, these antidepressant and anxiolytic effects are, among others, associated with exercise-induced differential functional connectivity of brain circuits involved in cognitive and emotion processing and prefrontal self-regulation (3, 28), overall lending support for the notion that, also during pandemics, exercise can lower vulnerability to and improve resilience against emotional distress. In line with this latter

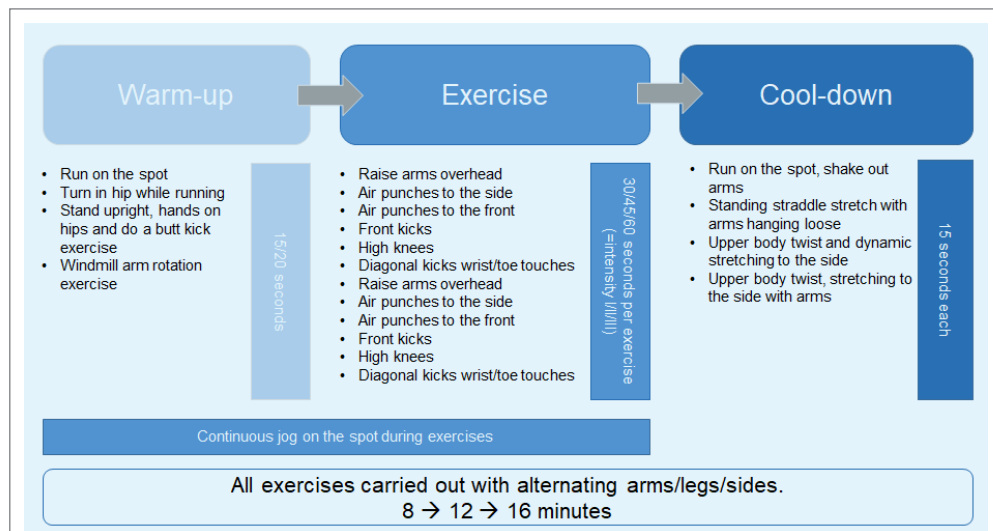


Figure 2

Description of the exercises provided in the aerobic exercise intervention. The full version of all exercises is available in the supplement and will be made available via the Exercise is Medicine homepage <https://www.exerciseismedicine.eu/exercise-is-medicine-deutschland/exercise-is-medicine-deutschland-1.html>. The exercises are taken from Herbert et al. (2020, (31)).

suggestions are results from cross-sectional or longitudinal studies investigating the stress buffering effects of regular aerobic exercise either in response to concrete laboratory stressors or real life stressors (see for an overview (26, 48)) in healthy subjects as well as in clinical patients in whom psychological stress has been implicated in the pathogenesis of the disorder such as depression, anxiety, but also coronary heart disease, obesity or vulnerability to infection (49). The findings converge on better physiological recovery from psychological stressors after regular aerobic exercise (19, 26) and lower perceived stress to real life stressors in healthy and clinical groups (48). Although effect sizes are reported to be small to moderate (e.g., 26, 32), these effects are noteworthy because pandemics as the current one increase psychological stress not only in care takers or patients but nearly in everybody. Moreover, psychological stress has been shown to correlate positively with unhealthy lifestyle practices and maladaptive coping behavior (54). Furthermore, an increase in distress promotes physical inactivity and sedentary behavior (54), thereby causing a vicious circle if physical inactivity and chronic psychological stress are increasing uncontrolled during pandemics without any offer of health care interventions that encourage peoples' motivation to engage in physical activity and regular exercise and that facilitate the access to exercise interventions to the general public.

### Psychological Effects

Noteworthy, with respect to exercise effects on mental health, one must also account the major psychological factors of physical activity as well as of acute and regular exercise on well-being. "Psychological" in this context means those factors that so far have not been directly related or discussed in the literature in relation to exercise-related changes in the functionality of the central nervous system (CNS), the autonomous nervous system (ANS) or the immune system (IS), and for whom significant psychophysiological and psychobiological interactions have so far not been confirmed as possible explanatory mechanisms. Psychologically speaking, social, cognitive, affective and motivational factors significantly affect and modulate exercise-related

Table 1

Stress and mental health effects of the aerobic exercise intervention according to (31).

### SIX WEEK AEROBIC EXERCISE INTERVENTION

Significant improvements in self-reported depression

Reduced state anxiety (trend)

Reduction of perceived stress due to uncertainty

Protection of cardiorespiratory fitness (compared to the non-exercising control group) in women after 2 weeks

Self-report: intervention alleviates stress and enhances well-being

changes in mood-, stress- and self-regulation independent from physical activity and exercise-related physiological training effects (45, 54; for an overview on psychophysiological/psychobiological models (26)). Improvements in physical self-concept and in self-efficacy, i.e., peoples' feelings of mastery, competence and control, the motivation to engage in exercise for physical or mental health reasons or for time out in order to cope or escape preoccupation with pandemic stressors, or anxiety-inducing factors, or worries, are all factors that can contribute to individual well-being, self-determination, personal growth, and feelings of dominance (being in control of the situation). Psychological effects of exercise help protect mental health and well-being by increasing resilience against chronic psychological stress which certainly also helps to reduce pandemic hypervigilance for symptoms of the pandemic disease (29, 58). Moreover, psychological factors play an important role in exercise adherence (21).

#### Exercise Type, Frequency, Intensity and Duration for Mental Health Achievements

This raises the question which type of physical activity and which exercises, of which intensity, duration and format (home-based, supervised, online, outdoors etc.) might help best for which person to fight the negative consequences on mental health elicited by the pandemic situation. As outlined in most recent meta-analytic studies and literature reviews, most evidence for exercise-related positive mental health benefits in secondary and primary prevention has been accumulated in studies investigating the effects of aerobic exercise but endurance exercises with a musculature strength or motor coordination and balance (e.g., yoga) have also been examined recently for their benefit for well-being (55). Furthermore, previous research has focused on the effectiveness of regular (i.e., weekly and daily) aerobic exercises of moderate intensity in line with WHO recommendations (58) to achieve significant health benefits in the prevention of non-communicable diseases (also known as chronic diseases). More recent recommendations, however, specifically focusing on mental health (for an overview see (55)) and targeting patients with mental disorders, somatic comorbidity as well as healthy individuals are less restrictive and suggest that dose-response relationships might vary across target populations and health outcomes (55). They therefore recommend to also include physical activities and aerobic exercises of lower intensity and also suggest to more strongly consider other factors i.e., psychological (see 2.2.4.), psychosocial (supervised exercise vs. exercising alone vs. in groups for social support), environmental (exercising indoors vs. outdoors) and life-domain factors (e.g., quality of life) for their role in supporting exercise adherence and positive health outcome (21, 55).

#### Material and Methods – Online Exercise Initiative

During the current pandemic, not all people have the opportunity to exercise outdoors without falling below the recommended social distance of 6-feet and 6-seconds (17). Therefore, as outlined in detail in the previous sections of this manuscript, there is an urgent need to provide people with scientific exercise recommendations (22) as well as with exercise interventions that allow them to engage in low- to moderate-intensity exercise without much effort at home. To increase exercise adherence at home, the interventions should require minimal exercise equipment to be performed at home. The type of exercise, exercise intensity and duration should be controlled to avoid emotionally unpleasant side effects of the exercise, the interventions should comprise warm-up and cool-down exercises to avoid injury risk, and the interventions should be supervised to e.g., battle social isolation of exercising alone.

We provide exercise interventions that can help support the maintenance of physical activity of low- to moderate-intensity during the current pandemic. The primary exercise interventions focus on aerobic exercise that, according to the scientific recommendations and the literature reviewed above, promotes mental health and additionally physical health by strengthening cardiovascular and cardiorespiratory fitness and muscular endurance. As shown in figure 2, the individual exercises chosen require the use of the arm and leg musculature for a minimum of 8 minutes per exercise session or a maximum of 16 minutes per exercise session. The exercise interventions we provide are modular, i.e., the exercises can be practiced individually and repeatedly across exercise sessions. Moreover, one can also choose to pick those exercises that individually work best, although it is scientifically recommended to complete the sessions as advised to ensure their protective effects on mental health (30). For those who have no permanent access to the internet or who prefer to practice on their own at their own pace, the exercises are available as written manual (see supplement). The manuals are available in English and German language to guarantee maximal dissemination irrespective of the native language of the user. A description of the individual exercises is provided in figure 2 and examples of the exercises are shown in figure 3. The manuals are available in the supplement. The effectiveness of the exercise interventions has been previously investigated in two independent pilot studies, whose results are briefly reviewed below (for a detailed overview see (31)). Moreover, to test the feasibility of the exercise interventions for the current purpose, i.e., dissemination to the public and home-based usage during the pandemic for health protection, we asked health professionals to rate each of the exercises on exercise-related dimension and on psychological dimensions to evaluate the health benefits of the individual exercises.

Results – Current Evidence of the Effectiveness of the Exercise Interventions

Previous Scientific Studies

For the exercise interventions we provide in this manuscript, we previously conducted two independent randomized controlled trial (RCT) pilot studies in healthy adults (157 women, 28 men; mean age=22.54 years, SD=2.93). The RCT studies were conducted as online and laboratory study (31). 153 participants took part in the online study and 32 participants (all-female sample) took part in the laboratory study, all university students from German universities. 36.6% of the participants of the online study (women and men) reported experiencing depressive symptoms at T1; 41.8% of them (women and men) reported high state anxiety. The participants reported to perceive stress due to uncertainty (worries about job, finances) and excessive demand (cognitive load) rather than due to experiencing real negative life events (dead, real job loss). Sitting behavior across leisure time and work time activities accumulated on average to 7 hours/day before the start of the interventions. Participants were randomly selected to three groups (aerobic exercise group, waiting list and non-exercise or motor coordination control group) and advised to practice for two weeks or six weeks according to the exercise routines depicted in figure 6 (see supplemental material online).

The aerobic exercise interventions were associated with significant changes in mental health, cardiorespiratory fitness and well-being in comparison to either pre to post intervention or in comparison to the non-exercise control groups. The aerobic exercise group reported significant improvements in self-reported depression, in overall perceived stress, and in perceived stress due to uncertainty after six weeks of exercise. State anxiety tended to be lower in those participants who completed the six week aerobic exercise interventions compared to the participants who took part in the six week non-exercise intervention. All participants of the aerobic exercise group experienced the intervention as effective in alleviating stress symptoms and in enhancing well-being. Participants (all women) who completed the two week aerobic exercise or engaged in the two week motor coordination exercise showed higher cardiorespiratory fitness (as measured by resting heart rate variability) compared to the waiting list group. The major findings are summarized in table 1, for further details please see (31).

Feasibility and Adherence of the Exercise Interventions across Age Groups: Expert Ratings

Expert Ratings  
To validate the feasibility of the exercise interventions for the general population, we asked health and exercise professionals



Figure 3 Examples of the aerobic exercises provided in the exercise intervention from Herbert et al. (2020, (31)).

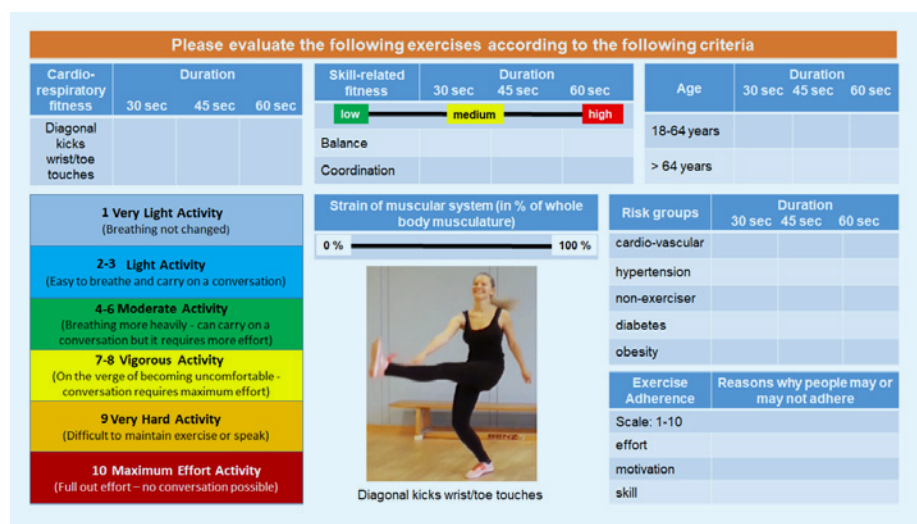


Figure 4 Expert ratings. Each exercise had to be rated by health professionals for its cardiorespiratory fitness, motor skill-related fitness, suitability of the exercise for certain risk groups and exercise adherence.

to rate each exercise in terms of standardized exercise components (16) and on psychological dimensions. The ratings included exercise intensity and duration, cardiorespiratory and motor skill-related fitness (balance and coordination), suitability across age groups for adults with and without history of lifestyle-related diseases, exercise motivation, and exercise adherence. Intensity of the exercise and cardiorespiratory fitness were rated on the Borg rating scales (10), motor skill-related fitness on percent scales (musculature: 0-100%), balance and coordination on scales from 1 (low) – 3 (high). Suitability for different age groups as well as suitability for certain risk groups (cardiovascular risk, hypertension, diabetes, obesity, and sedentarism) had to be rated on single-ended items (yes vs. no). Exercise adherence, i.e., possible reasons for why people might adhere or opt-out (e.g., 41), had to be rated on 10 point-Likert scales. In addition, we asked whether the exercise interventions are expected to have positive effects on the exerciser's self-concept including body image, self-efficacy, attention and concentration (neurocognitive functions), and whether they can be practiced at home. An overview of the expert rating is provided in figure 4.

The main results of the expert ratings (average across all experts, N=6) are reported descriptively in the user manuals using the median as descriptive outcome measure. Color >

coded symbols indicate the intensity of the exercise (see supplement). All experts agreed that the exercises (including warm-up and cool-down) address cardiorespiratory fitness at low to moderate intensity, with “low” meaning “talking and breathing at normal pace is possible”, and moderate meaning “breathing and talking is possible only under effort”. The cardiorespiratory fitness ratings of the experts ranged on average from 2-6 (median) on the Borg scale for all three durations (30 sec, 45 sec, 60 sec). With respect to motor skill-related fitness, the exercises were rated of moderate intensity and to require little effort for coordination and balance. All expert agreed that the exercises are suitable for healthy adults aged between 18-64 years. While some of the exercises were rated to be suitable for even higher age groups (64-99 years), potential risk groups (cardiovascular symptoms, hypertension, or obesity) and previously sedentary people should, according to expert ratings, train cautiously to avoid risk of injuries. Moreover, the exercises were rated as not too easy and not too physically demanding (median: 4-5 on a 10 point scale), rich in variety (little fatigue) and to require little exercise expertise. All experts suggested the exercises are suited for home-based training (median: 8) and rated the exercises as helpful for improving cardiorespiratory fitness, self-efficacy, positive body image, and neurocognitive/executive functions such as attention and concentration (all medians: 8 from 10 points on Likert scales).

### Conclusion and Future Outlook

Immediately after the first lockdowns, several initiatives were spread through the internet and media, all following one particular aim: To motivate and help people to stay at home while at the same time staying active during days, weeks and probably months of loss of social activities and outdoor exercises. Also, scientific institutions and scientific publications have provided first recommendations of how to combat the pandemic without increasing physical and mental ill health (18). By the present exercise initiative discussed in this article, we aim to outline the importance of physical activity and regular aerobic exercise for mental health prevention during the current pandemic and hope to help overcome physical inactivity by recommending exercise interventions for daily practice at home. The exercises we provide in this article have proven to stabilize individual well-being in major domains of mental health (depression, perceived stress) after six weeks of intervention in a healthy participant sample aged between 18 to 26 years (31). Crucially, the aerobic exercises have been rated by health experts as suitable for home-based exercise across age groups, and as not too difficult for people with pre-existing disorders. Thus, the exercise intervention we provide can be used by doctors and health professionals as a recommendation and exercise prescription for their patients and have been rated as supporting psychological factors (e.g., self-efficacy) which play an important role in exercise adherence. ■

### Conflict of Interest

*The authors have no conflict of interest.*

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