

Depression and High Intensity Interval Training Exercise

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He has no known conflict of interest to disclose.

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Abstract

Purpose: The COVID-19 pandemic has increased depression among the population. Exercise is a useful coping mechanism for depression and high intensity interval training (HIIT) can be utilized.

Background: A community exercise facility provides HIIT exercises for gym members. The gym owner believed their HIIT program is a great tool for coping with depression.

Methods: The gym offered a 21-day free HIIT program. Those who signed up for the program, 18 years of age or older, and were able to exercise under the Physical Activity Readiness Questionnaire were offered to participate in the study. Participants were given a pre-survey before they started exercises. This survey utilized the Patient Health Questionnaire-9 (PHQ-9), a standard depression rating tool that determines depression symptom prevalence. After the 21-day program, participants were given a post-survey involving the same PHQ-9. The survey scores were compared pre- to post-program. The surveys were coded to exclude any identifying information.

Results: Mean PHQ-9 pre-test was 7.67, mean score post-test was 3. A paired t-Test resulted in a $p=0.60$, showed that it was not statistically significant.

Discussion: The goal of this study was to determine if HIIT training was an effective coping mechanism for depression. The data shows that participants had decreased PHQ-9 scores from the pre- and post-program surveys showing a clinical significance. This data can be used to provide those suffering from depression a coping mechanism.

Depression and High Intensity Interval Training

The people of today are currently under the effects of a worldwide pandemic from an infectious virus known as COVID-19. The virus has swept the world and caused problems in every area of life, from economic, to health care. This virus has been devastating to everyone in one form or another. Due to the pandemic, quarantine orders were put in place worldwide to protect the population. Being in lockdown from quarantine or social distancing orders has made members of the population feel isolated and lacking support. The social distancing orders have prevented much of the population from going to their normal places for physical activity such as a gym and other social areas. When unable to do normal activities that are used to cope and improve mental and physical health this contributes to negative effects on mental health. These negative contributions to a persons' mental health can cause depression among other illnesses. Exercise may help positively improve mental health and be a great coping mechanism for depression. This paper will discuss the effects of exercise on mental health in persons suffering from depression

Problem Statement

Isolation

Social isolation due to the pandemic is causing a decline in mental health among the population. The isolation caused by the pandemic effects all ages. In a study by Knopf (2020), the researcher analyzed 63 articles on the effects of isolation and depression and found that depression and anxiety symptoms has increased during social distancing. Continued isolation and worries about COVID-19 itself will continue to affect those with depression.

Exercise

Isolation has also made it increasingly difficult for the population to partake in exercise. Gyms, social clubs, and other places people could get some physical activities were closed in many locations. In places where facilities were not closed, the fear of acquiring the virus prevented many from going out. Not participating in physical exercise has negative effects on not only mental health, but physical health as well. The article by Deguchi et al. (2020) describes that a lack of exercise can cause sarcopenia or reduction in muscle mass. With the pandemic causing social isolation and increasing depression, exercise may be a possible tool and coping mechanism.

Purpose and Rationale

According to the World Health Organization (2021) the COVID-19 virus has infected more than 119,603,700 people since discovery and over 2,649,700 people have died from it. In a study by Czeisler et al. (2020) during the pandemic, June 2020, 30.9 percent of adult respondents reported depression symptoms. This percentage shows a much-elevated level of mental health disorders versus previous years (Czeisler et al., 2020)

Social isolation had left many without regular coping mechanisms such as loved ones and physical activity. The World Health Organization (2021) states that about 280 million people are diagnosed with depression and that number is increasing significantly since the beginning of the pandemic. With depression on the rise due to restrictions, it is important to provide interventions to help those vulnerable. The purpose of this paper is to establish physical exercise, in the form of high intensity interval training (HIIT), as a coping mechanism for depression in the population at an exercise facility.

Background/Significance

Isolation

Isolation is the process of having minimal to no contact with other people. Pandemic isolation causing depression is a new territory in the world. The study by Krendl et al. (2021) showed that among the participants of the survey, 79.3 percent stated their social life was negatively impacted with 69 percent stating they were spending much less time with those they care about. Planchuelo-Gomez et al. (2020) conducted a study utilizing anxiety, stress, and depression survey scores in the population before and during lockdown isolation. This study found an increase in negative symptoms associated with all three; anxiety, stress, and depression (see Appendix A) (Planchuelo-Gomez et al., 2020). Mental health is a concern in the population because poor mental health can result in lower quality of life. In the study provided by Troutman et al. (2020) they noted that while the social isolation recommended by the CDC can be life-saving it also carries multiple mental health risks. They recommend socially distant activities that can provide the necessary socializing and physical activity. In a study by Mechling et al. (2019) they correlated peoples' persistent mental illnesses with lower quality of life scores on survey (see Appendix A).

Exercise

Exercise is any form of physical activity utilized to improve physical health. For the whole of the population, exercise is a positive intervention that has many health benefits. In a study on exercise and depression by Holmquist et al. (2017), they showed that exercise has increased prevention of depression. Physical activity helps with physical illness and has shown to be effective in mental illness as well. The article by Baker and Clark (2020) provides multiple interventions and rationales to help with a population isolated during the pandemic including; physical activity which helps a person's overall health, mental and physical. An exercise plan can be made to begin with physical activity. During lockdown in Norway, Ernsten et al. (2020)

did a study on the population that exercises and the general population and compared their mental health scores. Anxiety, insomnia, and depression reports had a significant drop in the exercise group (see Appendix A). Exercise has shown results in multiple studies improving peoples' mental health.

The researchers Deguchi et al. (2020) stated that at least one hour per week of any type of exercise helps prevent depression. As little time as one hour of a person's time every week can show positive effects of mental health. Fluetsch et al. (2019) did a cross-sectional study involving analyzing the data from the 2015 Behavioral Risk Factor Surveillance System and found that higher physical activity in adults saw fewer reported days of poor mental health (see Appendix A). One study by Huang et al. (2015), compared an exercise program to cognitive behavioral therapy for depression. The cognitive behavioral therapy showed a significant drop in depression symptoms among participants. The researchers went on to argue that the exercise program also showed a large improvement of symptoms, but may have a longer-term effect on those symptoms. The significance of this study is showing that the positive effect of exercise may have a longer lasting effect. Callow et al. (2020) note that physical activity is also beneficial in fighting the COVID-19 virus. In a 13-year-long study finding the correlation between exercise and cases of clinical depression by Hallgren et al. (2019), it was found that the population who engaged in physical activity had less cases (see Appendix A). Another study on depression and exercise from Bennie et al. (2020), the researchers discovered that the prevalence of depression symptoms was decreased on a self-report scale in an exercise group versus a control group (see Appendix A).

HIIT exercise is a specific form of physical exercise. During HIIT the person will undergo a vigorous activity for about 60 seconds followed by a short period of rest, this cycle

continues for an hour. This exercise is designed to quickly increase heart rate, while building muscle. Many gyms across the country offer HIIT as an exercise program.

Internal Evidence

An exercise facility that services a large population in Phoenix Arizona. This facility provides group physical activity classes to anyone 18 years old and up, of any fitness level. These classes were led by a fitness trainer, where they teach correct form for exercises. The owner of the gym utilized a health survey they developed for new clients that asks basic questions about mental health. The owner believed that the HIIT can help improve peoples' overall well-being, physical, and mental health. The owner had agreed to implement a standard mental health survey for this research study to participants before and after starting a standard physical activity program. This gym offers participants a 21-day free HIIT exercise program.

Discussion

The COVID-19 pandemic has been difficult for the whole world. All countries were affected by the introduction of the COVID-19 virus. Social distancing to stop the virus spread has left the population vulnerable to mental health issues. Many studies have been started since the beginning of the pandemic on this issue and have had results indicating the negative impact on mental health. There have also been many studies on the effects of exercise and mental health. These studies generally show a clear improvement in mental health.

PICO Question

This inquiry has led to the clinically relevant PICO question, "In the population, age 18 and older, affected by the COVID-19 pandemic, how does a structured exercise program affect depression symptoms versus no structured exercise program."

Search Strategy

A review of current evidence based on the PICOT question. Three databases were utilized; Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed, and PsychINFO. The databases were selected due to the relevancy on mental health as well as COVID-19 isolation. These databases contain quality, peer-reviewed material pertaining to the medical field.

Key Terms

When using the databases key terms were utilized to narrow and filter the results to address the PICOT question. Key terms included; depression, mental health, COVID-19, isolation, exercise and various synonyms and variations of each to be more inclusive. Some of the other filters applied included articles dated between the years 2016 and 2021, peer-reviewed journal articles, and English language. Geography filter was left out at this time.

Search Yield

The initial search of CINAHL using the key terms, exercise, and depression yielded 780 results. Once the key term isolation was added increased the results to 1,800, while adding COVID-19 reduced it to 28 results. These results were with the added filters of article date, peer-reviewed, and English language.

Searching PsychInfo using the same key terms from the CINAHL search; exercise and depression, yielded 100 results. Adding COVID-19 returned three results. Article dates between 2016-2021, and peer-reviewed filters were applied. COVID-19 is a new topic starting in 2020, thus adding COVID-19 to searches will produce a smaller number of results.

The PubMed database yielded over 10,000 results with the same initial key terms as above. Adding the key term isolation narrowed it down to 220 results, and adding COVID-19

brought it to 77 results. The filters applied were articles dated 2016-2021, English language, and peer-reviewed. This database yielded the most initial results with all key terms and filters applied.

From these databases after reviewing the titles and abstracts of articles, 20 relevant studies were selected. Full text copies of these 20 studies were obtained and reviewed using a critical appraisal checklist. From the checklist, 11 studies showed high quality research relevant to the PICOT question. These studies included six description studies, four randomized control trials, one systematic review.

Inclusion and Exclusion Criteria

Inclusion criteria included studies looking at depression symptoms in the population 18 years or older in isolation and studies that tested the effects of exercise on depression symptoms. Exclusion criteria included studies looking into only the physical outcomes of exercise or isolation. Without a huge pool of studies to compare at this time, the selection of studies was limited. Another limitation is with the pandemic being new to the world, long term effects cannot be determined. These studies all evaluate parts of the PICOT question including; mental health during lockdown and isolation, and the effects of exercise on mental health.

Critical Appraisal & Synthesis of Evidence

The quality and strength of evidence of the articles was determined utilizing a rapid critical appraisal tool that was developed by Melnyk & Fineout-Overholt (2019). The studies were quantitative, measuring scores on several mental health questionnaires, that applied scores based on symptoms. These studies were chosen based on their relevance to mental health and isolation, or exercise, or both isolation and exercise. These studies were included in evaluation and synthesis tables (see Appendix A).

The majority of participants in the studies were defined as anyone older than 18 years of age. Demographics were widely varied, but favored female over male in many studies. Study tools included standard mental health questionnaires in all studies although the studies used several different types. The types of exercise varied greatly from study to study, but were well defined within each. Due to the variance of exercise, it is impossible to determine if a specific type of exercise is better for mental health than another. From this evidence there is a clear relation between the positive effects of exercise and mental health including; depression, anxiety, and stress. People suffering from mental health issues should consider exercise as a viable option for improvement of mental health.

Theory Application

The Health Promotion Model (HPM) was chosen because the model endorses activities that help improve and maintain well-being (see Appendix B). Polit et al. (2017) describe the assumptions of HPM as a person who will actively regulate their behavior when there are valued benefits in doing so. This model also iterates that people change and are changed by the environment around them and health care professionals can exert their influence on those peoples' environment. It is up to the person to change their behavior on the environment for positive outcomes (Polit et al., 2017). This model is directed towards promoting health, utilizing exercise for the improvement of mental health fits into this belief. The environment during the pandemic is one that can promote isolation which has been shown through studies to decrease mental health. While not explicitly stated in the research studies in this paper, most seem to employ the HPM as well. This model will assist in promoting behaviors that assist in well-being such as exercise.

Implementation Framework

This research study implements an evidence-based practice model known as the Iowa Model for Evidence-Based Practice to Promote Quality Care or Iowa Model (see Appendix B). According to Polit et al. (2017) this model begins with identifying the problem-focused trigger, in this case the problem being poor mental health outcomes during COVID-19 isolation and how exercise affects this. The next step is to assemble research on the topic, critique and synthesize the research (see Appendix A). Once a sufficient research base is developed, then begins the pilot of change in practice; selecting outcomes, collect data, implementation, evaluation, and modify practice. If this change project is appropriate for adoption, then there can be initiation of change in practice, or continued evaluation of quality, followed with dissemination of results (Polit et al., 2017).

Methods

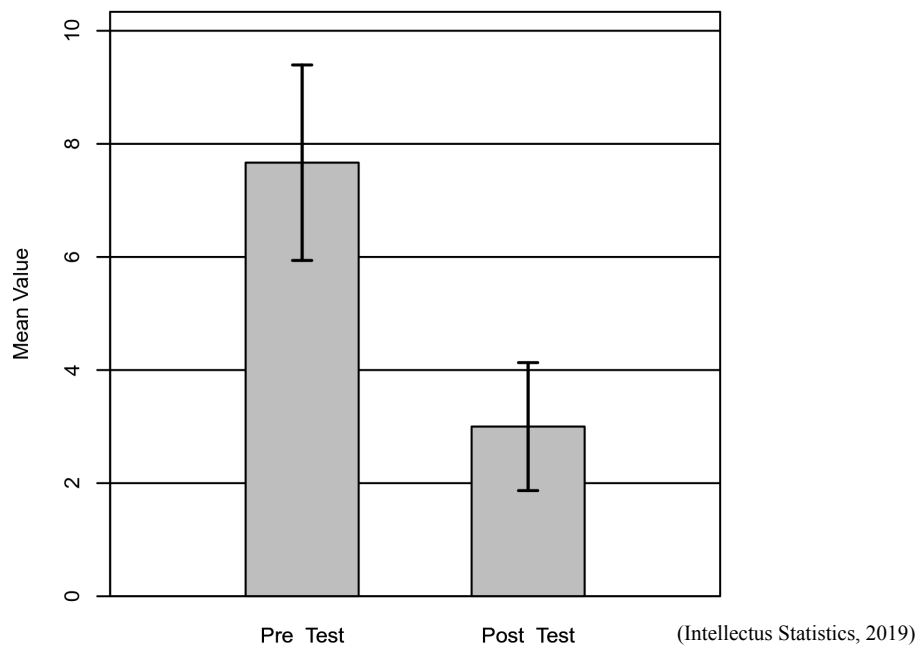
The participants were those who came to the gym and signed up for the 21-day exercise program. The participants had to be 18 years and older, male or female, and any race. Exclusion criteria included: people under 18 years old, those who cannot participate in the physical activities as deemed by the Physical Activity Readiness Questionnaire, and those who do not finish the program. Those who signed up were sent an e-mail with the necessary information and survey. It was made clear that taking the survey was consent to start the program. The participants then completed the pre-program survey, completed the exercise program, then completed the post-program survey. Participants names were excluded from the data obtained, and the results were stored on the nurse practitioner student's computer, until DNP program completion. Data on symptoms of depression were then compared.

Outcomes were measured utilizing the Patient Health Questionnaire-9 (PHQ-9) (see Appendix C). The PHQ-9 is a questionnaire that measures severity of depression symptoms. According to Kroenke (2001), the PHQ-9 is modeled after the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5). The diagnostic symptom criteria in the DSM-5 are relayed in the survey as nine questions with a Likert-scale from zero to four score of severity associated with it. Kroenke (2001) conducted a study where 6,000 patients completed the PHQ-9 and as the severity scores increased so did a decrease in functional status, concluding that the PHQ-9 is a reliable tool for depression severity. This survey is commonly used among mental health practitioners in assisting a diagnosis of depression (Kroenke, 2001). The PHQ-9 scores were compared from pre-program to post-program surveys. The change in scores were collected to see if the program had any effect on depression severity. These measures relate to the HPM because the participants were seeking an intervention with a perceived value, that being a healthy lifestyle. The environment being the exercise program provided the change people are seeking. The Iowa Model related to the outcomes because it identified a problem causing trigger, depression, then found outcomes. The outcome was change in depression symptoms after exercise program completion. The project was implemented, data collected, then evaluated for effectiveness. If the data is shown to be effective the project can be evaluated for quality and information disseminated to other locations.

Study was not started until Arizona State University's Institutional Review Boards approval (see Appendix D). Collection of data began in November, 2021 and ended in January, 2022. There was no budget or funding provided on this project. The outcome of this project was expected to show that HIIT would be a positive coping mechanism for depression.

Results

There were 74 participants that signed up for the initial program information and survey. Three participants completed the entire program and surveys. The mean PHQ-9 score of the three participants before the program began was 7.67. The mean PHQ-9 score of the three participants after program completion was 3. The scores were compared using Intellectus Statistics (2019), a paired t-Test to determine if the difference in mean was statistically significant, the $p=0.60$.



Discussion

The results showed that each participant had a reduction in depression symptoms scored on the PHQ-9. This means there was a clinical significance that HIIT reduced depression symptoms. The data did not reach statistical significance with the $p=0.60$. More participants would have likely made the data reach statistical significance.

Due to the nature of the exercise being higher intensity, there was an anticipated loss in participants who would drop out in the middle of the program. Participants left after one or two

weeks of exercise, did not complete two days of exercise per week, or did not complete the surveys. The gym owner did provide free 21-days of exercise for free for participants, this allowed for a lot of initial participants. The free program also allowed participants to leave without financial consequences. The owner highly endorses the mental health benefits of HIIT exercises and helped promote the program at the facility. Future studies need to have more participants finish the program to gain statistical significance. Future studies should also look into other aspects of mental illness such as anxiety.

Conclusion

People having the ability to head back into their normal routines, exercise facilities, and social areas can help with that increase of depression diagnoses since the pandemic started. This provides an opportunity for the population to find new coping mechanisms for depression. HIIT needs continued study and evidence for its efficacy as a coping mechanism. However, the data suggests that HIIT exercises do reduce depression symptoms on a PHQ-9 scale. Providers can offer exercise as a coping mechanism to their clients and HIIT could be part of that recommendation.

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Appendix A

Table 1

Evaluation Table of Quantitative Studies

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
(Fluetsch et al., 2019) Country: USA Analyzing data from the BRFSS and correlating the number of poor mental health days to level of physical activity.	Not explicitly stated, Health Promotion Model implied. Quantitative	Cross-sectional Purpose: To show the correlation between exercise and poor mental health days.	Inclusion/exclusion criteria: 50 years or older, able to walk outside for 10 minutes, no medical conditions or cognitive limitations, and at least mild depression. n =441,456 Control: age: 18-65 and older male: 48.7% female: 51.3%	IV – Exercise DV – Poor mental health days due to depression, anxiety, and/or stress.	Self-reported poor mental health days on the BRFSS.	Multiple linear regression model Being insufficiently active reduced days of poor mental health by -1.34 days/month (95% CI: -1.27, -1.41), being active by -2.03 days/month (95% CI: -1.96, -2.10), and being highly active by -2.23 days/month (95% CI: -2.17, -2.29)	Increase in levels of physical activity reduced the reported poor mental health days among the population.	Limitation: Study was not randomized, individuals were selected based on if they chose to enter the exercise program or not. Larger amount of people in the exercise group. PICOT: The exercise program shows evidence of effectiveness on depression.

Key: **BDI** – Beck Depression Inventory; **BRFSS** - 2015 Behavioral Risk Factor Surveillance System; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **MSE** – Muscle Strengthening Exercise; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
<p>Losing to gain: The effects of a healthy lifestyle intervention on the physical and psychosocial well-being of clients in a community- based mental health setting.</p> <p>Funded by J. Richard Corbett Charitable Trust (Grant No. #621120).</p> <p>No bias reported.</p>	<p>Social Cognitive Theory.</p> <p>Quantitative</p>	<p>Quasi- experimental between subject group research design.</p> <p>Purpose was to examine the effects of HLIs on patient's with SPMI.</p>	<p>Inclusion/Exclusion criteria: Over the age of 18, diagnosed with SPMI, physically able to perform various physical exercise.</p> <p>n – 54 Intervention- 33 Control - 21</p>	<p>IV – Anxiety symptoms DV - HLIs</p>	PGWBI	<p>Multiple comparison independent t- test. Control: (M =18.42, SD =5.00; t(55)=-2.70, p=.009)</p> <p>Intervention: p (M=12.50, SD=2.16; t(56)=-2.79, p=.007)</p>	<p>Mean anxiety symptoms as reported by PGWBI were 14.42 for the intervention group, and 18.42 for control group at three months. This shows improvement of anxiety symptoms after HLI's.</p> <p>No change at six months.</p>	<p>Limitations: Sample was not randomly assigned, attrition from initial participants occurred.</p> <p>PICOT: Continued support on the effectiveness of exercise on anxiety.</p>

Key: **BDI** – Beck Depression Inventory; **BRFSS** - 2015 Behavioral Risk Factor Surveillance System; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **MSE** – Muscle Strengthening Exercise; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
(Hallgren et al., 2019) Country: Sweden Funding by regional agreement on medical training and clinical research between Stockholm County Council and Karolinska Institutet. Bias not noted.	Not explicitly stated, Health Promotion Model implied. Quantitative Title: Prospective associations between physical activity and clinician diagnosed major depressive disorder in adults: A 13-year cohort study.	Longitudinal association Compare cases of depression among different activity level groups over 13- year period.	Inclusion/Exclusion Criteria: Older than 18 years, excluded for diagnosed mental disorder. n – 25,520	IV – Cases of Depression DV – Physical activity levels; Below (<150 minutes a week) Achieve (150- 299 minutes a week) Exceed (>300 minutes a week)	Clinical cases of depression	Cox proportional hazard regression model. Engaging in ≥300 min of MVPA per week reduce the risk of depression by 25% compared to engaging in <150 min per week (HR 0.75, 95% CI = 0.58– 0.97)	Hazard Ratio Below: 1 Achieve: 0.86 Exceed: 0.75	Increased physical activity correlated with less cases of depression over 13- year period. Limitations: self- reported instruments used for physical activity PICOT: Shows associations between physical activity and depression.

Key: **BDI** – Beck Depression Inventory; **BRFSS** - 2015 Behavioral Risk Factor Surveillance System; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **MSE** – Muscle Strengthening Exercise; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
<p>(Bennie et al., 2020)</p> <p>Muscle-strengthening exercise and depressive symptom severity among a nationally representative sample of 23,635 German adults</p> <p>Country: Germany</p> <p>Funded by the Social and Health Sciences in Sport Institute of Sport Science, University of Bayreuth.</p>	<p>Not explicitly stated, Health Promotion Model implied.</p> <p>Quantitative</p>	<p>Cross-sectional study.</p> <p>Examine associations between MSE and depression symptoms.</p>	<p>Inclusion/Exclusion : 18 years or older.</p> <p>n – 23,635 Male – 10,735 Female – 12,900</p> <p>People who did MSE in amount of times per week; 0=13,367 1=3085 2=2990 3-4=2531 >5=1662</p>	<p>IV – Cases of Depression</p> <p>DV – MSE in days per week;</p>	PHQ-8	<p>Generalized linear models with Poisson regression – used to calculate prevalence ratios. Prevalence of moderate depression symptoms, in exercises per week:</p> <p>1 times per week 0.62 (0.52–0.73) 2 time per week 0.66 (0.56–0.79) 3-4 times per week 0.72 (0.60–0.86)</p>	<p>For Moderate depressive symptoms, the prevalence were as follows;</p> <p>0 - 7.8% 1 – 5.5% 2 – 5.6 % 3-4 – 5.6% >5 – 4.7%</p> <p>Other levels of depression scores were similar.</p>	<p>Limitations: Study was on a self-report scale. Significantly higher amount of people in the 0 category leading to potentially skewed numbers.</p> <p>MSE was associated with decreased likelihood of depressive symptoms.</p> <p>PICOT: Shows strength exercise effects on depression symptoms. Also shows different types of exercise</p>

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
(Planchuelo-Gomez et al., 2020) Country: Spain Longitudinal evaluation of the psychological impact of the COVID-19 crisis in Spain. No Funding. No bias noted.	Not explicitly stated, Health Promotion Model implied. Quantitative	Longitudinal study. Examine symptoms of depression, anxiety, and stress due to the impact of the COVID-19 virus and lockdown.	Inclusion: Age 18 years and older, living in Spain. Mass survey sent out to population on March 28, 2020, second survey sent out to participants on April 28, 2020. n – 4,724 Male – 1,626 Female – 3,098	IV – Depression, Anxiety, Stress. DV – Lockdown from COVID-19	DASS-21 IES	Longitudinal analysis with Generalized Linear Mixed Models. Percentage of people who reported symptoms before compared to after lockdown. Such as 34.00% and 37.03% for anxiety.	Percentage in people who reported symptoms from first to second survey. Anxiety: 34% to 37.03% Depression: 44.41% to 46.88% Stress: 39.30% to 49.34%	Levels of anxiety, depression, and especially stress, significantly increased through the lockdown. Limitations: participants younger than 35 composed more than half of the sample. Majority of female participants PICOT: Shows increase in negative mental health symptoms from lockdown.

Key: **BDI** – Beck Depression Inventory; **BRFSS** - 2015 Behavioral Risk Factor Surveillance System; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **MSE** – Muscle Strengthening Exercise; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
<p>(Ernstsen et al., 2021)</p> <p>Country: Norway</p> <p>Mental health and sleep disturbances in physically active adults during the COVID-19 lockdown in Norway.</p> <p>Funding by Eckbo's Family Foundation, Saving Bank of Mid-Norway's Research Fund for NTNU, and Dam Foundation.</p>	<p>Not explicitly stated, Health Promotion Model implied</p> <p>Quantitative</p>	<p>Cross-sectional study.</p> <p>Assess mental health and sleep disturbances among physically active adults during lockdown in Norway.</p>	<p>Inclusion – Members of Norwegian fitness association.</p> <p>E-mail sent to members for online survey.</p> <p>n – 1281 Female – 397 Male - 884</p>	<p>IV – Depression, Anxiety, Sleep disturbance</p> <p>DV – Lockdown from COVID-19</p>	<p>HADS</p> <p>Karolinska Sleep Questionnaire.</p>	<p>Binary logistic regression</p> <p>Authors stated that data is not shown.</p>	<p>The percentage of participants reporting symptoms was compared to general population. Percentage of people reporting symptoms decreased</p> <p>Anxiety: 9% in physically active group to 14.2% in general population.</p>	<p>Limitation: Study took place during lockdown, impossible to know everything about sample population before lockdown, therefore not possible to conclude the results of this study are accurate.</p> <p>PICOT: Shows the effects of lockdown on mental health.</p>

Key: **BDI** – Beck Depression Inventory; **BRFSS** - 2015 Behavioral Risk Factor Surveillance System; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **MSE** – Muscle Strengthening Exercise; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice/ application to practice
(Callow et al, 2020) Country: United States of America and Canada The Mental health benefits of physical activity in older adults survive the COVID-19 pandemic. No funding noted.	Not explicitly stated, Health Promotion Model implied. Quantitative	Descriptive cross-sectional study Examine association between physical activity levels and anxiety and depression symptoms.	Inclusion/exclusion criteria: Older than 50 years old who completed the survey. n – 1,046 age – 50+ Male – 212 Female - 834	IV – Physical Activity DV – Depression scale scores	PASE GDS GAS	Multiple linear regression	If $p < 0.05$ is significant in the amount of activity and lowering depression scores in a linear regression model. Light activity: 0.03 Moderate activity: 0.04 Vigorous activity: 0.03 No relationship between exercise and GAS Bias toward GDS scores due to low amount of GAS analysis	Limitation: Impossible to determine if physical activity decreased depression symptoms or if increased depression symptoms decreased physical activity. Future studies should use more objective measures in determining how the pandemic is affecting the population. PICOT: Shows benefits of physical activity on mental health.

Key: **BDI** – Beck Depression Inventory; **DASS-21** – Depression Anxiety and Stress Scale; **DV** – dependent variable; **GAS** – Geriatric Anxiety Scale; **GDS** – Geriatric Depression Scale; **HADS** – Hospital Anxiety and Depression Scale; **HLI** – Healthy Lifestyle Interventions (diet and exercise); **IV** – independent variable; **MMSE** – Mini-Mental State Exam; **n** – number of participants; **OPQOL** – Older People Quality of Life questionnaire; **PASE** – Physical Activity Scale for the Elderly; **PGWBI** – Psychological General Well-being Index; **PSS** – Perceived Stress Scale; **QOL-AD** - Quality of Life in Alzheimer's Disease; **SPMI** – Severe and Persistent Mental Illness; **SWLS** – Satisfaction With Life Scale.

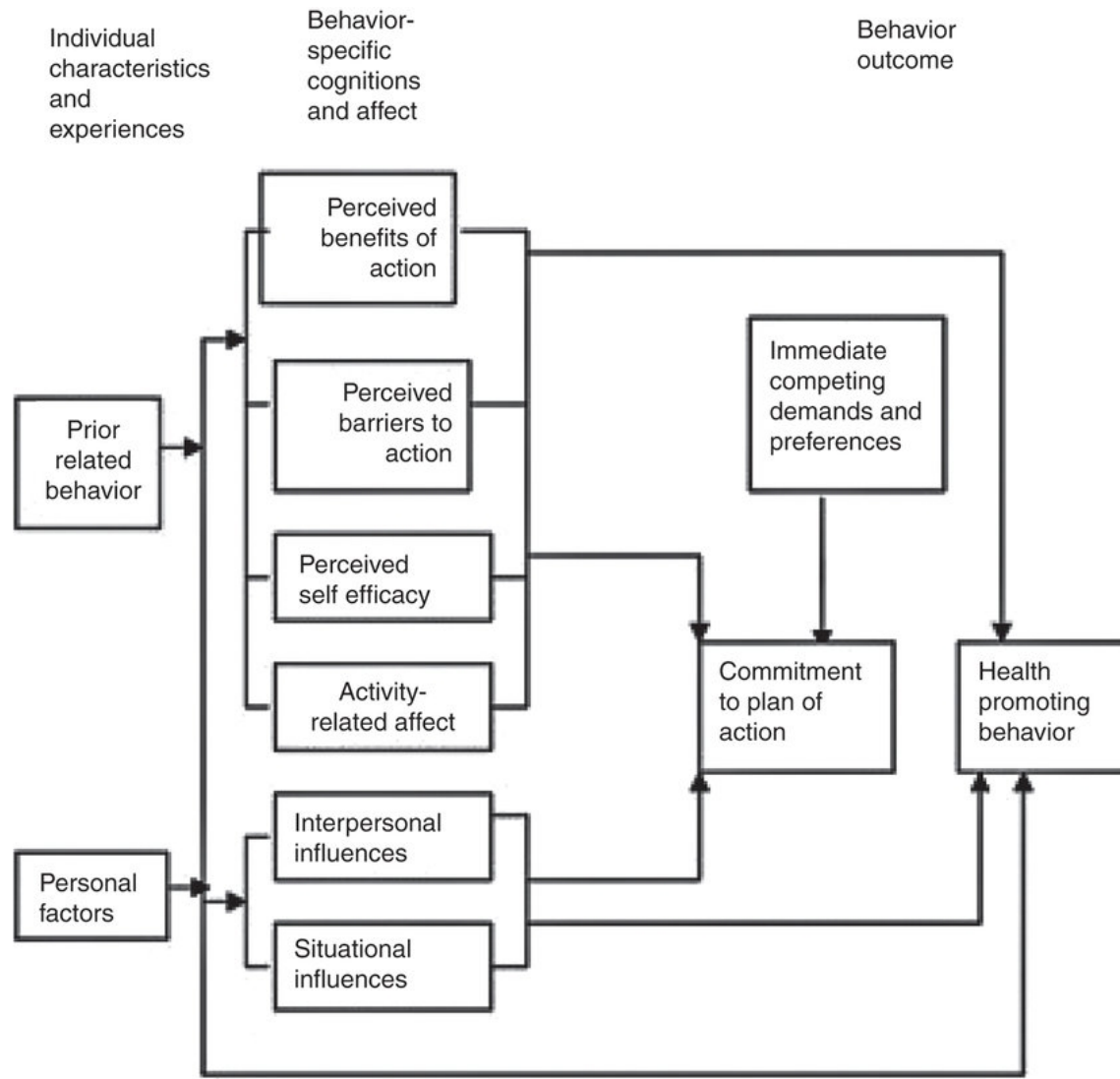
Table 2*Synthesis Table*

Study (Author, Year)	(Fluetsch et al., 2019)	(Mechling et al., 2019)	(Hallgren et al., 2019)	(Bennie et al., 2020)	(Planchuelo-Gomez et al., 2020)	(Ernstsen et al., 2021)	(Callow et al, 2020)
Design	Cross-Sectional	Quasi-experimental	Longitudinal association	Cross-sectional	Longitudinal association	Cross-sectional	Exploratory analysis
Sample							
n subjects	441,456	54	25,520	23,635	4,724	1281	1,046
Country	USA	USA	Sweden	Germany	Spain	Norway	USA
Framework	HPM	SCT	HPM	HPM	HPM	HPM	HPM
Outcomes							
Anxiety	+	+	-	-	+	+	-
Depression	+	-	+	+	+	-	+
Stress	+	-	-	-	+	-	-
QOL	-	-	-	-	-	-	-
Exercise	Exercise	Exercise	Exercise	Exercise	Isolation	Both	Both
Isolation							
Both							

Key: HPM - Health Promotion Model; n – Number of participants; QOL – Quality of Life; SCT – Social Cognitive Theory

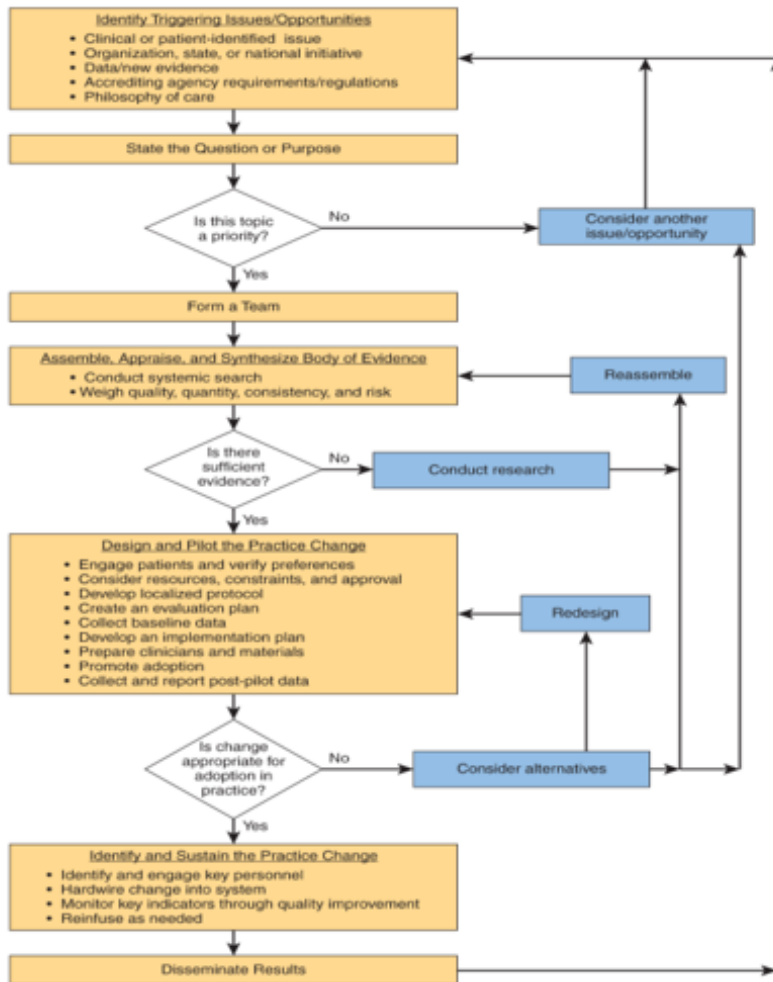
Appendix B

Health Promotion Model



(Pender, 2011)

Iowa Model



(Iowa Model Collaborative, 2017)

Appendix C

Patient Health Questionnaire-9

Over the last 2 weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself – or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

For office coding: Total Score _____ = _____ + _____ + _____

Total Score _____ (Kroenke, 2001)

Appendix D

IRB Correspondence Letter



APPROVAL: EXPEDITED REVIEW

Ann GutheryEDSON: DNP

602/496-0794 Ann.Guthery@asu.edu

Dear Ann Guthery:

On 10/28/2021 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Depression and HIIT Exercise
Investigator:	<u>Ann Guthery</u>
IRB ID:	STUDY00014790
Category of review:	
Funding:	None
Grant Title:	None
Grant ID:	None

Documents Reviewed:	<ul style="list-style-type: none"> • Intro letter with consent details, Category: Consent Form; • Letter with modification replies., Category: Other; • Pre-survey, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);
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The IRB approved the protocol from 10/28/2021 to 10/27/2022 inclusive. Three weeks before 10/27/2022 you are to submit a completed Continuing Review application and required attachments to request continuing approval or closure.

If continuing review approval is not granted before the expiration date of 10/27/2022 approval of this protocol expires on that date.

When consent is appropriate, you must use final, watermarked versions available under the “Documents” tab in ERA-IRB. In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

REMINDER - All in-person interactions with human subjects require the completion of the ASU Daily Health Check by the ASU members prior to the interaction and the use of face coverings by researchers, research teams and research participants during the interaction. These requirements will minimize risk, protect health and support a safe research environment. These requirements apply both on- and off-campus. The above change is effective as of July 29th 2021 until further notice and replaces all previously published guidance. Thank you for your continued commitment to ensuring a healthy and productive ASU community.

Sincerely,

IRB Administrator
cc: Kolter Smith