EFFECTS OF EXERCISE ON ANHEDONIA AND DEPRESSION

A Systematic Review

Presented to the faculty of the School of Nursing
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Charles Anthony Jennings
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Abstract

EFFECTS OF EXERCISE ON ANHEDONIA AND DEPRESSION
A SYSTEMATIC REVIEW
by
Charles Anthony Jennings

Statement of Problem
Persons who suffer from major depressive disorders often experience high levels of anhedonia, an inability to experience pleasure. To experience true relief from a major depressive disorder, sufferers need to experience both a decrease in the negative feelings associated with depression and an increase in the ability to experience pleasure.

Sources of Data
Three databases were searched to find previous studies regarding this topic. Inclusion criteria included exercise, anhedonia and depression. Fourteen articles were selected for systematic review. Articles reviewed included meta-analyses, previous systematic reviews, randomized control trials, cross-sectional survey studies and controlled trials.

Conclusions Reached
Studies support an inverse relationship between exercise and negative symptoms of depression. Increased exercise correlates with decreased depression. A similar inverse relationship is found between exercise and anhedonia. Increased exercise correlates with decreased anhedonia. Though studies varied in types and amounts of exercise, there is broad agreement that a
minimum of three exercise sessions per week lasting at least 30 minutes may provide a positive effect in both depressive symptoms and anhedonia in patients with depression.

Committee Chair

Dr. Nancy Coffin-Ronnig

12-2-13
Date
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INTRODUCTION

Depression is a serious medical condition with major negative impact on individuals, families and societies. Figures from the World Health Organization rank depression fourth in Disability Adjusted Life Years (DALYs) with a projection that moves depression into a ranking of second in DALYs by 2030 (Eriksson & Gard, 2011, p. 262). According to the DSM-V, depression is associated with a high mortality rate and as many as 15% of sufferers of major depressive disorders will die by suicide (American Psychiatric Association [APA], 2013).

There are nine possible criteria that define a major depressive episode. Five of the nine criteria must be present to establish the diagnosis. The first two criteria are the most common and both are associated with feelings experienced by the affected individual. Criterion number one requires that the person be experiencing a depressed mood most of the day, nearly every day. The second criterion requires that the person be experiencing anhedonia, described as diminished interest or pleasure in activities (APA, 2013). It is not uncommon for sufferers of depression to experience both the first and second criteria in major depressive disorder. They will feel sad most of the time and unable to experience pleasure when opportunities arise to participate in pleasurable activities.

It is significant to note that these criteria, while seeming similar are not the same. In the same way that a person can experience both criteria at once, a person also may experience only one of the first two criteria. A person could feel sad most of the time but still be able to enjoy an activity when the opportunity for participation in a pleasurable activity arises. Likewise, a person may not perceive themselves as feeling sad most of the time but may be able to identify that they no longer enjoy activities that were previously pleasurable. Effective treatment for a person
suffering from both criterion one and two would mean that the person not only reports spending less time feeling sad but also reports being able to enjoy pleasurable activities.

THE PROBLEM

Background

Depression has both physiological and psychological symptoms. Physiological symptoms include decreased appetite, sleep difficulties, poor concentration and decision making. These symptoms occur as a result of cortisol secretion. During depressive episodes, secretion of cortisol depletes supplies of serotonin (5-HT) and norepinephrine (NE). Decreased 5-HT levels in the frontal cortex and the hypothalamus create the physiologic symptoms of depression (Woo & Wynne, 2011). The recommended treatment for these physiologic symptoms is psychopharmacology. The first line of drugs recommended for treatment of depression is the Serotonin-Selective Reuptake Inhibitors (SSRIs) (Woo & Wynne, 2011).

Psychological symptoms of depression vary from person to person but there are two primary psychological symptoms that may occur, either alone or together. First, the person may be feeling sad most of time, nearly every day. Second, the person may be unable to experience pleasure with activities that would have been pleasurable in the past (anhedonia). A major depressive episode must include one of these two criteria and may include both (APA, 2013). These two criteria have similarities but are actually quite different. While both involve the affective nature of the depressed individual, the first is a subjective assessment by the individual of a current feeling state, that of feeling sad. The second criterion involves the absence of a feeling, specifically the feeling of pleasure.

Anhedonia, the second criterion in the diagnosis of a depressive episode, is distinct from the physiologic symptoms of depression. Its neuropathology involves the neurotransmitter
dopamine as opposed to serotonin and norepinephrine involved in the physiologic symptoms of depression (Levanthal, 2012). It is posited that anhedonia may have an inverse relationship with exercise. Studies have shown that physical activity increases dopaminergic activity in the striatum. Therefore, it is possible that physical activity may counteract anhedonia (Levanthal, 2012).

Because depression includes both physiological and psychological symptoms, a multi-modal approach is recommended. Treatment should include both pharmacological and non-pharmacological therapies. The primary recommended non-pharmacologic treatment is psychotherapy (Woo & Wynne, 2011). However, many interventions, including exercise, have been shown to be helpful in treatment of depression. An extensive meta-analysis conducted in 2013 by the Centre for Mental Health Nursing Innovation concluded that exercise is moderately effective in reducing the symptoms of depression (Stanton & Happell, 2013).

Both psychopharmacologic treatment and psychological treatments such as psychotherapy and other non-pharmacological treatments have been shown to be effective. A systematic review conducted in 2012 included two trials that demonstrated no significant difference in remission of depression symptoms between antidepressant medication therapy and psychotherapy. Both were equally effective (Cox et al., 2012). Because both have been shown to be effective, many people choose non-pharmacologic treatment for depression. Although psychotherapy is the first line non-pharmacologic treatment, exercise is an important intervention to include, both because of its positive effects on depression and numerous other physical benefits gained from exercise (Perraton, Kumar, & Machotka, 2010).
Theoretical Framework

The central concepts of this study come from Margaret Newman’s theory, “Health as expanding consciousness” (McEwen & Willis, 2007, p. 208). In Newman’s theory, health is seen as a transformative process whereby one moves to a state of increased inclusion in consciousness (Brown, 2011). Movement is a central concept of transformation. “Newman described movement as the fullest expression of consciousness. Through movement, we come to know our world, others, and ourselves” (Picard, 2000, p. 150). The independent variable in this systematic review is movement in the form of exercise, therefore, Newman’s theory provides a perfect guide for the researcher as the review is completed.

Other concepts from Newman’s theory that are significant to this research are person, consciousness, and pattern. Person is defined as “a dynamic pattern of energy and an open system in connection with the environment” (McEwen Willis, 2007, p.209). Consciousness is defined as “the information of the system; the capacity of the system to interact with the environment” (McEwen and Willis, 2007, p. 209). Pattern is defined in Newman’s theory as “relatedness, which is characterized by movement, diversity, and rhythm” (McEwen & Willis, 2007, p. 209).

Newman posited that good research embodies the theory, rather than just paying tribute to the theory or recognizing the theory (Picard, 2000). This systematic review embodies the theory of Health as Expanding Consciousness. Newman’s theory refers to evolving patterns of consciousness. These patterns are not isolated but are part of the whole. Every individual has their own pattern of interactions that constantly occur between themselves and their environment (Brown, 2011). People experiencing depression have developed patterns that limit their expanding consciousness. What are called symptoms of depression could be seen as patterns.
Isolation, suicidal thoughts, inability to experience pleasure, depressed mood, and irritability are all patterns of the whole in persons with depression. They reflect both an inner and an outer pattern of movement that does not support expanding consciousness. Newman defines expanding consciousness as “the increasing complexity of the living system characterized by illumination and pattern recognition” (McEwen & Willis, 2007, p. 209). The central idea behind researching exercise as an intervention for depression is to discover whether physical movement can change emotional patterns, thereby supporting expansion of consciousness and improving health. In accordance with Newman’s theory, a person is thought of as a unitary whole being in relationship with the surrounding world, with each part of the being affecting, changing, and growing with the whole being (Vandemark, 2006). Using Newman’s theory, Vandemark (2006) posits that movement in one aspect of a being must create some kind of movement in all aspects of the being. In the research reviewed in this paper, movement in the form of physical exercise is tested for its effects on movement in the emotional sphere, measured as improvement in depression and anhedonia.

Please see the theoretical framework below that illustrates the relationship between increased movement and improvement in symptoms of depression.
Figure 1: Conceptual Model: Health as Expanding Consciousness/Exercise/Depression

Above concept map designed by this author based on the work of Margaret Newman (McEwen & Willis, 2007).

Research Variables

In this systematic review, the intervention of exercise as part of a treatment plan for depression and anhedonia will be evaluated for effectiveness in reducing symptoms of a depressive episode, including the symptom of anhedonia. Of particular interest will be the overall effectiveness of exercise in reducing symptoms, amount of exercise needed to produce results, most effective types of exercise, and frequency of exercise needed. Exercise is the dependent variable, manipulated in various studies to affect the independent variable, level of depressive symptoms in depressive episodes. For this review, exercise is defined as an activity that requires physical exertion that is planned and structured. Examples include any type of exercise that involves a specific activity for a set period of time and a pre-set number of times per week, such as walking 30 minutes 3 times per week or performing a pre-determined workout.
routine three times per week. Activities such as walking, jogging, biking, and swimming are typical examples. Strength training programs also qualify if they are planned and structured. Activities like gardening and housework do not qualify as exercise for this review as they typically are not structured activities included in an exercise plan. Exercise may also be referred to as “physical activity” in some studies but typically these studies define physical activity in much the same way as exercise is defined in this review.

**Problem Statement**

The problem addressed in this systematic review is that depression is a multi-faceted illness that includes both physiologic and psychological symptoms. Recommendations for treatment of depression include both pharmacologic and non-pharmacologic treatment. Pharmacologic treatment and psychotherapy have been studied extensively and have been found to be equally effective when used independently. There is some evidence to support the use of combination therapy, including both medication and psychotherapy (Cox et al., 2012). Because studies have shown non-pharmacological interventions to be effective, many people that suffer from depressive episodes avoid the expense and risk of medications as part of their treatment plan. Therefore, it is important that treatment plans for depressive episodes include all effective non-pharmacological interventions.

Multiple studies have examined exercise as a non-pharmacologic intervention for depression and found that exercise is effective, both as a stand-alone intervention and as an adjunct to medication or psychotherapy (Stanton & Happell, 2013). This review looks at the problem of how to best utilize exercise as an intervention for depression.
**Research Question**

Current published research will be reviewed in an attempt to answer the following question. Does the intervention of exercise in persons with depression, decrease the negative symptoms of depression; increase the ability to experience pleasure or both?

**Significance to Nursing**

For nursing, a deeper understanding of the role of exercise as an intervention for depression could have a profound impact on treatment planning for patients with depression. Currently, in the inpatient setting, the discharge plan routinely addresses current medications, including antidepressants. The discharge plan for a patient with depression also usually recommends psychotherapy and often includes the date of the next appointment with a therapist. However, inpatient discharge plans rarely address the benefits of exercise. If all inpatient staff nurses understood the impact of exercise on depression, treatment planning might look different. Every patient being discharged after treatment for depression could have a recommended exercise regimen as part of their discharge plan. The exercise routine could be specifically tailored to the needs and abilities of each person. For discharged patients with financial means, personal trainers, gym memberships and/or fitness classes could be included in the discharge plan specifically to help alleviate relapses of depression. For those that lack financial resources, community resources that include free exercise classes could be recommended along with a recommendation for a personal exercise regimen.

Outpatient nursing would be impacted in a similar manner. For all patients battling depression, routine assessments and re-assessments would include questions about current exercise practices. Nurses would provide written and verbal education about the need for routine
exercise to prevent relapse of depression. New tools could be developed to encourage compliance with exercise regimens.

From a societal and global perspective, the impact on nursing could be profound. Nurses that understand the positive impacts of exercise on depression could lead the way in changing the way depression is treated to assure that exercise is always a part of the relapse prevention strategy. A successful nursing campaign to add exercise to the treatment plans for all depressed patients could make a profound positive difference in society. Depression is currently ranked fourth in the World Health Organization’s DALYs (Eriksson & Gard, 2011). If even a small percentage of patients suffering from depression were able to prevent relapses in their depression, the effects of this serious medical illness could be lessened.

SEARCH STRATEGY

The intention for this systematic review was to locate available previous research on the effects of exercise on depression and anhedonia for the purpose of adding to the literature on best practices for treatment planning for patients with depression. A literature search was conducted using CINAHL Plus with full text, PsycINFO, and PubMed Central. Search phrases included “depression and exercise”, “depression and aerobic”, “depression and resistance training”, “depression and cardio”, “exercise and anhedonia”, “depression and activity” and “anhedonia”. These searches yielded a total of 3,495 articles. Further screening to assure that articles matched the intent of the review narrowed the appropriate articles substantially. Additional limits on searches included screening for articles published in 2008 or later and screening for articles that included previous systematic reviews, randomized control trials, cross-sectional survey studies and controlled trials. In addition to databases, reference lists from existing articles were reviewed. After careful screening for inclusion and exclusion criteria, 43 full text articles were
analyzed for inclusion in this systematic review. A total of 14 articles were accepted for final review, based on meeting all requirements for inclusion, having no exclusion requirements and being identified as having significant information to contribute to this body of work dedicated to contributing to the literature on best practices for use of exercise as an intervention in treatment of depression.

**Figure 2: Flow Chart of Systematic review**

- **Identification**
  - Databases: CINAHL, PubMed, PsycINFO
  - # of articles 3,495
  - 9 additional articles were identified via reference lists from existing articles

- **Screening**
  - # of records after duplicates removed: 1646
  - # of records screened: 1219
  - # of records excluded: 1176

- **Eligibility**
  - # of full text articles assessed for eligibility: 43
  - # of full-text articles excluded: 29
  - 5 articles reviewed duplicate studies, 8 articles contained editorial comments, and 16 did not contain inclusion criteria

- **Included**
  - # of studies included in systematic review: 14
Selection Criteria

The search of databases and reference lists provided a preliminary list of potential previous studies. Terms used for selection criteria included “exercise”, “anhedonia”, “depression”, “cardio”, “aerobic”, “activity” and “resistance”. When used as individual key words for the search, each word produced thousands of articles. Therefore, search words were combined to produce a more refined list. Specifically, searches included the combinations “exercise and depression”, “exercise and anhedonia”, “cardio and depression”, “resistance training and depression”, “aerobic and depression” and “activity and depression”. Many articles appeared in multiple searches but ultimately, four sets of articles were compiled to review for inclusion or exclusion criteria. Sets included studies that specifically included anhedonia, studies that included exercise and depression, studies that used only cardio or aerobic types of exercise and studies that included resistance or strength training. Efforts were made to assure that studies reflected exercise as an intervention across the lifespan.

Inclusion Criteria

To meet the criteria for this systematic review, an article was either a publication of a previous research study, a previous systematic review or a meta-analysis. A review of each abstract was conducted. As long as there was at least one inclusion criterion and no exclusion criterion, the article was considered for further review. The publication of the article was from a peer reviewed journal and was published in English. Studies included used a validated depression scale such as the Patient Health Questionnaire, Beck’s Depression Scale, Hamilton Depression Rating Scale, or a similar widely validated instrument. Studies used a measured form of exercise as an intervention with a reliable and validated instrument for measuring exercise.
Originally, randomization was to be required for previous studies but some significant studies did not include randomization. Blinding was not a requirement for these studies since it is actually impossible to blind exercise as an intervention. Participants in all studies were aware that their level of exercise was being measured in regards to its impact on depression. Likewise, originally, a specific diagnosis of a depressive disorder was to be included but after careful consideration, this criterion was removed. It was determined that use of a valid depression scale was sufficient to demonstrate change in level of depression for participants without requiring an official diagnosis of depression for inclusion. Several longitudinal studies began with healthy individuals and monitored exercise over a long period of time while also assessing exercise levels over that time period. These were important studies for determining whether exercising provided protection against depression over a long period of time.

Types of exercise used in studies could include aerobic exercises such as walking, jogging, swimming or other exercises that create an elevated heart rate, strength training or resistance training, or a combination of aerobic and strength training. No specific target for the amount of exercise was set but methods of measurement for the exercise were an inclusion factor. Further information on methods of measurement of exercise is included in the exclusion section. Many studies refer to exercise as physical activity without using the term “exercise”. This was considered acceptable as long as the physical exercise was measured using a valid tool and was of the type of exercise mentioned above. Aerobic exercise of any type or strength training or a combination of aerobic and strength training was required.

Age of participants in studies included persons aged 5 and over. Most studies were of adults only. A small number of studies included adolescents. One study included children aged 5-11. One study was specific to the geriatric population. This allowed for inclusion of studies
specific to depression across the lifespan. Studies of any type of depression, including post-partum depression were included, as long as the intervention used in the study was some form of measured exercise. Length of studies was left open-ended and included at least two time measurements. Initial review of abstracts revealed that exercise programs were most effective if they lasted at least eight weeks (Perraton et al., 2010) but the large variations in lengths of studies prohibited identifying a specific timeline for inclusion or exclusion. Dates of publications of articles were set at 2008 or later. Dates of actual research conducted were left more open-ended to include some significant early research on the topic and the inclusion of cohort studies conducted over long periods of time. All included studies had at least one inclusion criterion and no exclusion criterion.

**Exclusion Criteria**

Articles published prior to 2008 were excluded. Studies that included children 12 years of age and younger were excluded, with one exception. One longitudinal cohort study that covered a six year period with children was included as the study was considered significant and added to the goal of addressing exercise interventions in depression across the lifespan. Studies were required to use only one intervention; exercise. However, participants could be using pharmacologic interventions simultaneous to the exercise intervention. Ideally, pharmacologic intervention should not be a new form of treatment and there should be no changes in the pharmacologic intervention during the study. However, most studies did not include monitoring of changes in pharmacological interventions. Participants could also be receiving psychotherapy simultaneous to the introduction of exercise as an intervention. Studies were excluded that measured exercise using self-reports only with no other means of validating whether the participant was truly exercising. If self-reporting was used but with a specific measurement tool
such as an exercise calendar or another validated tool for measuring exercise, then self-reporting 
did not automatically exclude a study. Studies that involved measurement of single episodes of 
exercise only were excluded. Studies that classified physical exercise as “any type of movement” 
without some identification of parameters were excluded.

In the case of previous research studies, the location of the study was not considered for 
inclusion or exclusion. The search revealed that many studies are conducted outside the United 
States of America. As long as the article appeared in a peer reviewed professional journal 
published in English and met all other inclusion criteria, it was reviewed for this study.

Organization of Review

Studies accepted for review were categorized across the lifespan. Articles reviewed 
included studies with children, adolescents, adults and older adults. When reviewing studies that 
include information about age and analysis of age as a factor, lifespan information was included 
in this review. Gender of study participants was not considered for inclusion or exclusion. 
Studies that included statistical analysis of gender based data reported mixed results with most 
showing no statistically significant difference in the effect of exercise in relation to gender 
(Perraton et al., 2010). Most studies showed that both genders benefited equally from exercise as 
an intervention for depression.

Across the Lifespan

One study included persons ages 6-20. Three studies included adolescents, ages 11-19. 
Eight studies included adults, ages 18-65. One study included older adults, ages 65 and over. 
One study included participants from across the lifespan, ages 11-100. Though age was 
identified in all studies, age was not typically measured as a variable or included in calculations 
of statistics. Results from studies in all age ranges were similar with recommendations for
introducing exercise as an intervention for either treatment or prevention of depression in all age ranges.

**Strengths**

Studies included in this review were conducted around the world and included a variety of ages and scenarios. The common bond of each study was the introduction of exercise as an intervention for symptoms of depression or the retroactive analyzing of data in regards to exercise and its impact on depression. Broad inclusion criteria in regards to age, gender and location allow results to be applied across a broader spectrum. The strict criteria regarding exclusion of studies that did not use a validated instrument strengthened the validity of the outcome. By including only those studies that used validated instruments, each study was considered comparable to the others. The gathering of information from a wide variety of sources opens the door for further studies to identify specific, best-practice details for introducing exercise as an intervention in the treatment of depression and/or anhedonia.

**Limitations**

The original intent of this review was to focus on the effects of exercise on anhedonia. It was quickly determined that there is limited research specific to the use of exercise as an intervention for anhedonia. Therefore, the study was expanded to include the effects of exercise on depression in general. This review has identified a clear need for additional research on the effects of exercise on anhedonia. Also, the use of “exercise” as a key word caused the search to produce many results, increasing the time required to filter articles down to include only those specific to exercise as an intervention in the treatment of depression.

The choice to include studies from anywhere in the world could, in theory, alter the outcome. For instance, if a study was conducted in a country actively engaged in war, symptoms
that mimic depression could be related to Post Traumatic Stress Disorder. Likewise, a study conducted in a country with extreme poverty might not produce results consistent with a study conducted in a developed country. Study participants living in poverty might exhibit depressive symptoms that are actually related to the inability to meet basic human needs. These symptoms may not necessarily subside as a result of the introduction of exercise as an intervention. Therefore, it is possible for results to be skewed based on location of the study. Overall, however, including all study locations increases the strength of the study by expanding the potential application of the results.

Some bias may also exist in certain studies as a result of how the study was funded. At least one study was funded by a pharmaceutical company. Several studies were funded by universities but did not identify how the university came to have grant money available for the study. Ultimately, any researcher conducting a study that is paid for by an individual or organization that has a vested interest in the outcome of the study is at risk of introducing bias into the study. Since funding for some of these studies was not clearly identified and this could have introduced bias into some studies.

QUALITY APPRAISAL

The Level of Evidence Table (Melnyk & Fineout-Overholt, 2011) was used to assess each article for quality. This table rates research articles on a scale of I-VII with a level I rating reflecting a study with the highest quality of evidence and level VII being the lowest quality of evidence. The aim of this systematic review was to use high quality studies so that the results would include a high level of reliability, allowing this review to provide strong evidence. The level of evidence for each article was recorded in a table created by Melnyk & Fineout-Overholt (2011). The results for each article can be viewed in Table 3 found at the end of the article. All
studies achieved a rating of I-IV. No studies had a quality rating of V or higher. The key for the Melnyk & Fineout-Overholt (2011) table is shown below.

**Figure 3: Key for Melnyk & Fineout-Overholt (2011) Instrument**

**Level Scale: I-VII (for each study) (Melnyk & Fineout-Overholt, 2011)**

- **Level 1** - Systematic review & meta-analysis of randomized controlled trials; clinical guidelines based on systematic reviews or meta-analyses
- **Level 2** - One or more randomized controlled trials
- **Level 3** - Controlled trial (no randomization)
- **Level 4** - Case-control or cohort study
- **Level 5** - Systematic review of descriptive & qualitative studies
- **Level 6** - Single descriptive or qualitative study
- **Level 7** - Expert opinion


**Results for Level of Evidence**

A variety of types of studies were included in this systematic review. Strong efforts were made to assure that only studies using scientific research designs with clear documentation of proper methodology for securing participation, obtaining data, and analyzing data were included. Adhering to a strict set of inclusion and exclusion criteria was difficult. Some flexibility was required but all studies met high quality standards. Previous systematic reviews contained important information and were included in this review. These often contained a wide variety of studies. If the majority of the studies in the review met all criteria for this systematic review but there was a valid reason for including a criterion identified in this review as an excluded
criterion, the study was still included. For example, self-reported exercise data was considered an excluded criterion for single studies but was considered for systematic reviews that contained some studies that included self-reporting of exercise. However, the self-reports were all completed using validated tools for measuring either levels of difficulty of exercise or time spent exercising or a combination of time and difficulty.

**Level of evidence for each article**

A total of 14 articles met the criteria for this systematic review. The level of evidence assigned to each article was based on type of research design and the use of proper research methods in the study using the Level of Evidence Table by Melnyk & Fineout-Overholt, 2011. Table 3 identifies the level of evidence of each article. The key for Table 3 can be found above. Table 3 can be found at the end of the article. Each study was ranked on an I-VII scale with “I” being the highest quality of level of evidence and “VII” being a lower quality of evidence. All articles had valid research designs but some designs supplied higher reliability of data because of their design. Non-randomized controlled trials were included in this review because they provided sufficient significant data to warrant inclusion but they did not supply as high a quality of reliability as the systematic reviews with meta-analysis studies.

**Dependent variable**

**Level of depression**

Thirteen studies chose to measure the level of depression as the dependent variable. Studies used a wide variety of validated tools to measure depression. Seven of the thirteen studies achieved a level I rating. Four studies achieved a level IV rating. Two studies achieved a level III rating. No studies were rated level V or greater. Overall, the level of evidence was high in the thirteen articles that measured depression as the dependent variable.
Level of Anhedonia

One study measured the level of anhedonia as the dependent variable. This study achieved a level III rating. It was a cross-sectional correlational study of 157 college students. The study used four different tools to measure anhedonia and depression (Levanthal, 2012). This study was very significant in this review as it was the only study that specifically addressed anhedonia and used tools designed to measure anhedonia rather than just depression scales.

Instruments for Measurement of Dependent Variables

There were a variety of instruments used to measure depression and anhedonia. All instruments chosen in these studies had been previously validated and their validation was discussed in each article. In at least one study, performed in Mexico, the tool used was validated for use in both English and Spanish (Gallegos-Carrillo et al., 2013).

Anhedonia Scales

Levanthal, 2012, used three different scales to measure anhedonia and one to measure depression. The Snaith Hamilton Pleasure Scale (SHAPS) is a 14 item questionnaire that measures the capacity to experience pleasure. The Tripartite Pleasure Inventory (TPI) is a self-report scale that measures the participants’ level of pleasure felt with certain experiences. The scale uses a reverse Likert system ranging from 4-0 with 4 being no pleasure at all and 0 being extreme pleasure. The Physical Activity Enjoyment Scale (PAES) measures affective response to physical activity (Levanthal, 2012).

Depression Scales

A wide variety of scales was used to measure depression. Six studies were meta-analysis studies or systematic reviews that did not list specific tools but did identify that studies reviewed
had used validated tools. Three studies used the Center for Epidemiologic Studies Depression scale (CESD). Two studies used the Patient-Health Questionnaire-9 (PHQ-9). One study used the Short Moods and Feelings Questionnaire (SMFQ). One study used the Children’s Depression Inventory (CDI). One study used the Major Depression Inventory (MDI) and one study used the Beck Depression Inventory (BDI). All of these tools have been used extensively and are considered valid tools for measurement of depression.

**Methods for Intervention Delivery**

Exercise was the intervention common to all studies but the specific type of exercise varied. The two primary categories of exercise were aerobic training and non-aerobic training, also known as resistance training. The definition of aerobic exercise varied slightly among studies but in general, was defined as exercise that caused the participant to reach and sustain 60-85% of their maximum heart rate (Shomaker et al., 2012). Types of aerobic exercise included walking, running, cycling, dancing, aerobics classes, and swimming. Non-aerobic training was typically weight lifting or some other form of progressive resistance. Non-aerobic exercise was always structured and often conducted in group settings. Commonly, non-aerobic classes consisted of a trained professional leading a group in progressive resistance of large muscle groups using machines. Many of the studies assured that the measured exercise was done in a structured setting, rather than just a self-report of independent exercise activity.

**Instruments for Measurement of the Independent Variable**

The measured independent variable in every study was exercise, also referred to in some studies as physical activity. Some measurement tools used to measure exercise included the use of metabolic equivalents (METs) as the unit of measure. METs were calculated using minutes of time spent in a physical activity and the level of intensity of the exercise. When METs were used
in a study the Compendium of Physical Activities was used to assign METs to each activity (Gallegos-Carrillo et al., 2013). Using METs to measure exercise is common in scientific studies that include measurement of exercise. METs have been validated for use in exercise measurement tools with strong quality standards (Gallegos-Carrillo et al., 2013). All studies used some type of validated tool to measure exercise.

**Exercise Scales**

Seven of the studies were systematic reviews or meta-analyses. These studies reported the use of a variety of validated measurement tools but did not identify specific tools used. The most common tool used in RCTs was the International Physical Activity Questionnaire (IPAQ). This validated tool measures activity on a low/moderate/vigorous scale. Vigorous is defined as causing perspiration and shortness of breath (Levanthal, 2012). Longitudinal studies typically used scales that involved measurement of minutes per week of exercise along with an IPAQ type of questionnaire used to determine level of vigor achieved during exercise. These studies typically used the METs system discussed previously to assign levels of exercise. The longitudinal study conducted in Mexico used an internationally validated questionnaire that ranked levels of physical activity as highly active, moderately active, or inactive (Gallegos-Carrillo et al., 2013).

**Results of Studies Included in This Systematic Review**

All of the studies reported some type of positive effect of exercise on depression. Each study added its own body of information to the current collective wisdom regarding the use of exercise as an intervention for treatment of depression and anhedonia. This study clearly supports Margaret Newman’s Health as Expanding Consciousness (HEC) theory. Her concept of integration via movement, the idea that movement patterns reflect the person’s inner patterns and
organization, is clearly reflected in depressed persons. These studies show that people with depression move less and that as they move more, their depression improves. Using the terminology of HEC, movement, in the form of exercise or physical activity expands consciousness. Newman defines consciousness as “the capacity of the system to interact with the environment” (McEwen & Willis, 2007, p. 209). Increased interaction with the environment in the form of increased exercise decreases depression which could be seen as increasing expansion of consciousness.

Please see the table below created by this author for the results of each study included in this review. Additional tables regarding grading of recommendations and levels of evidence are included later.

**Table 1: Results of Systematic Review**

<table>
<thead>
<tr>
<th>Study</th>
<th>Lifespan Cycle</th>
<th>Type of study</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown, Pearson, Braithwaite, Brown, &amp; Biddle, 2013</td>
<td>Children and adolescents</td>
<td>Systematic review and meta-analysis</td>
<td>Small significant overall effect for physical activity on depression</td>
</tr>
<tr>
<td>Brunet et al., 2013</td>
<td>Adolescents</td>
<td>10 year prospective study</td>
<td>Sustained levels of moderate to vigorous physical activities over time may potentiate prevention of depression.</td>
</tr>
<tr>
<td>Shomaker et al., 2012</td>
<td>Adolescents</td>
<td>Cross-sectional, correlational non-randomized study</td>
<td>Significant association between depression and low physical activity. Association between anhedonia and poor cardiovascular fitness. Depression prompts withdrawal from physical activity</td>
</tr>
<tr>
<td>Rothon et al., 2010</td>
<td>Adolescents</td>
<td>Prospective cohort longitudinal cross-sectional study</td>
<td>Evidence of an association between physical activity and depression with an 8% decrease in the likelihood of depression with each hour of weekly exercise</td>
</tr>
<tr>
<td>Levanthal, 2012</td>
<td>Young adults (college students aged 19-24)</td>
<td>Cross-sectional correlational study</td>
<td>Inverse relationship between anhedonia and walking frequency and/or moderate-intensity physical activity</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Population</td>
<td>Study Type</td>
<td>Findings</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>Krogh, Nordentoft, Sterne, &amp; Lawlor, 2011</td>
<td>Adults</td>
<td>Systematic review and meta-analysis</td>
<td>Exercise interventions may have a small short-term antidepressant effect that ends with cessation of exercise program</td>
</tr>
<tr>
<td>Perraton et al., 2010</td>
<td>Adults</td>
<td>Systematic review of RCTs</td>
<td>Evidence supports supervised aerobic exercise at least 3 times per week for 30 minutes as intervention for depression</td>
</tr>
<tr>
<td>Cooney et al., 2013</td>
<td>Adults</td>
<td>Systematic review and meta-analysis of RCTs</td>
<td>Exercise provided a moderate positive clinical effect on depression</td>
</tr>
<tr>
<td>Eriksson &amp; Gard, 2011</td>
<td>Adults</td>
<td>Systematic review of RCTs</td>
<td>Seven of eight studies showed exercise to be an effective intervention</td>
</tr>
<tr>
<td>Gavric, Markovic, &amp; Cukafic, 2012</td>
<td>Adults</td>
<td>Correlational Study</td>
<td>Moderate physical activity was correlated to a decrease in depression symptoms</td>
</tr>
<tr>
<td>Gallegos-Carrillo et al., 2013</td>
<td>Adults</td>
<td>Prospective cohort longitudinal study</td>
<td>High levels of physical activity provided a significant protective effect against development of depression</td>
</tr>
<tr>
<td>Stanton &amp; Happell, 2013</td>
<td>Adults</td>
<td>Systematic review</td>
<td>Both aerobic and resistance exercise are moderately effective interventions. Neither has been conclusively shown to be superior. A combination is recommended</td>
</tr>
<tr>
<td>Loprinzi, 2013</td>
<td>Older adults, aged 65 and over</td>
<td>Controlled trial</td>
<td>Every 60 minute increase in light physical activity produced a 20% decrease in likelihood of depression</td>
</tr>
<tr>
<td>Mammen &amp; Faulkner, 2013</td>
<td>Across the lifespan, ages 5-100</td>
<td>Systematic review of prospective studies</td>
<td>Overall, studies show physical activity decreases depression but the stricter the adherence to quality measures, the lower the significance of the results</td>
</tr>
</tbody>
</table>

**Grading of Recommendations**

Grading of recommendations was completed using the Joanna Briggs Institute (2008) tool. The tool was used to determine four aspects of exercise as an intervention; feasibility, appropriateness, meaningfulness, and effectiveness. Each of these four areas were ranked using an ABC scale with A representing strong support for use, B representing moderate support for use and C representing no support for use. The tool was used once to determine recommendations for exercise as an intervention for depression and once to determine
recommendations for exercise as an intervention for anhedonia. The determination for recommendations of exercise for depression was based on 13 studies with levels of evidence ranging from I-IV. The determination for recommendations of exercise for anhedonia was based on one study with a level of evidenced score of III (Melnyk & Fineout-Overholt, 2011). Please see the tables below grading of recommendations using the Joanna Briggs Institute (2008) instrument.

Table 2a. Grading of Recommendations Table: Exercise as intervention for depression

<table>
<thead>
<tr>
<th>Grade Of Rec</th>
<th>Feasibility</th>
<th>Appropriateness</th>
<th>Meaningfulness</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
</tr>
<tr>
<td>B</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
</tr>
<tr>
<td>C</td>
<td>Not Supported</td>
<td>Not Supported</td>
<td>Not Supported</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

From the Joanna Briggs Institute (Joanna Briggs Institute [JBI], 2008)

Table 2b. Grading of Recommendations Table: Exercise as intervention for anhedonia.

<table>
<thead>
<tr>
<th>Grade of Rec</th>
<th>Feasibility</th>
<th>Appropriateness</th>
<th>Meaningfulness</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
</tr>
<tr>
<td>B</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
<td>Moderate support that merits consideration for application</td>
</tr>
<tr>
<td>C</td>
<td>Not Supported</td>
<td>Not Supported</td>
<td>Not Supported</td>
<td>Not Supported</td>
</tr>
</tbody>
</table>

From Joanna Briggs Institute (Joanna Briggs Institute [JBI], 2008)
Feasibility

The Joanna Briggs Institute defines feasibility as “practicality and utility of an intervention…factors that affect decision making among policy makers, clinicians, and patients” (Joanna Briggs Institute [JBI], 2008, p. 2). Exercise as an intervention for both depression and anhedonia received a “B” rating, representing moderate support for use. There are two primary reasons for this ranking. The first is that evidence from this study supports supervised group exercise as the most effective type of intervention. Group exercise involves training, expense and time. The second is that all forms of exercise require participation. Exercise is not a passive intervention. Several studies in this review discussed the difficulty with compliance to exercise regimens. The feasibility of getting full cooperation of policy-makers to establish and pay for exercise programs to prevent or treat depression is only moderate at best. Also, the feasibility of compliance to an exercise regimen by a depressed individual is moderate.

Appropriateness

In this table from the Joanna Briggs Institute, appropriateness is defined as “evidence about the extent to which an activity or intervention is ethical or culturally apt” (JBI, 2008, p. 4). As an intervention for depression, exercise received an appropriateness rating of “A”. The studies in this review spanned many cultures and all age ranges. Studies were reported from the United States of America, Mexico, Bosnia and Herzegovina, Canada, Australia, Sweden, Denmark and the United Kingdom. Participants ranged in age from 5-100. There was no indication in any study that exercise would be an inappropriate intervention in any culture or any age range. Exercise as an intervention for anhedonia was given a “B” rating simply because of lack of sufficient studies to support strong recommendations. Further studies could potentially reveal cultural issues related to anhedonia that do not apply to depression in general. For
instance, some cultures might have a gender-based bias against expression of happiness. For instance, women in Middle Eastern countries that abide by strict religious laws may not be allowed to express emotion publically. This could mean that any intervention that addresses anhedonia might be considered culturally inappropriate.

Meaningfulness

The Joanna Briggs Institute defines meaningfulness as “evidence about the personal opinions, experiences, values, thoughts, beliefs or interpretations of clients and their families or significant others” (JBI, 2008, p. 5). The definition provided by JBI causes a dilemma with grading this particular attribute. All of these studies are quantitative, not qualitative. There was no evidence gathered in regards to client or family opinions or beliefs. In order to provide a rating in this category, the opinions and thoughts of the researchers were considered. A score of “B” was given for both anhedonia and depression. In reality, these studies are very meaningful and contribute important information to the body of literature regarding exercise as an intervention. However, since the belief that these studies are meaningful is coming from the researcher rather than the participant, the grade really can’t be an “A” according to the definition provided by JBI.

Effectiveness

The Joanna Briggs Institute defines effectiveness as “evidence about the effects of a specific intervention on specific outcomes” (JBI, 2008, p. 5). Exercise as an intervention for depression received an “A” rating for effectiveness. Thirteen of thirteen studies showed at least minimal positive effect of exercise on depression. Several showed strong positive effect. All researchers recommended either further research or implementation of an exercise intervention. Exercise as an intervention for anhedonia was given a “B” rating for effectiveness. This is due to
the limited amount of research available. Only one study was specific to anhedonia. While this study showed exercise to have a positive effect on anhedonia, it also clearly showed a need for further research specific to anhedonia.

CONCLUSION

Several important conclusions can be reached after reviewing the results of this systematic review. First, exercise clearly has at least minimal effects on depression. Second, there is a very limited body of evidence specific to anhedonia, but the information available points to the possibility that exercise may be an effective intervention for increasing the pleasure potential of people suffering from depression. Third, there is a strong need for further high quality research on exercise and anhedonia. In addition, while there are some specific recommendations made for detailed intervention implementation, there is still a great need for clinical validation of best practices in regards to recommendations for exercise in treatment of depression.

Evidence Related to Research Question

The question addressed in this systematic review was: Does the intervention of exercise in a treatment plan for depression decrease the negative symptoms of depression; increase the ability to experience pleasure or both? The evidence gathered indicates that exercise is a valid intervention for depression. There is also very limited information available that supports exercise as an intervention for anhedonia. There is still a great need for additional studies specific to interventions addressing anhedonia. There is also a strong need for studies that review success rates of actual implementation of exercise as an intervention in day to day operations of health care settings.

Limitations of Systematic Review
One question that was not addressed in this systematic review is “in real-life settings, will people diagnosed with depression participate when exercise is recommended as an intervention?” The research is clear that exercise decreases some negative symptoms of depression and may increase the ability to experience pleasure, but those results are contingent upon participation by a depressed person in an exercise regimen. Before proceeding with additional studies that mimic current research, the focus could be shifted to include studies that set out to determine if people with depression have the motivation to participate in exercise as an intervention.

A strong limitation to all research related to treatment of depression is the subjective nature of feelings. The instruments used in the studies contained in this review were all validated, well-established tools but they cannot account for the fact that the symptoms of depression are always self-appraised. This makes nearly all research on depression subject to bias and skewed data introduced by the participant.

Most of the exercise measured in the studies contained in this review involved supervised group exercise. A limit brought on by this type of intervention is the possibility that the positive impacts of the intervention are the results of social interactions with peers in the group or even a therapeutic relationship between the participant and the group leader. Scientifically, supervised exercise increases the validity of the exercise data but it could possibly skew the correlations made between exercise and depressive symptoms since the improvement may not be accurately attributed to the intervention.

**Implications for Nursing and Future Research**

In recent years, a great deal has been learned about the human brain and depression. This may provide a more objective method of determining effectiveness of interventions. The
introduction of various types of brain scans during interventions could provide much needed information about whether interventions, including exercise, are really impacting depression. It is clear that further research on exercise as an intervention for both depression and anhedonia is needed. It is important that studies be of the highest quality and whenever possible, provides objective information.

Exercise as an intervention for depression has strong implications for nursing practice. Nearly all nurses work with depressed patients. As role models for patients, it is important that nurses embrace and embody a lifestyle that promotes prevention of depression. Nurses need to increase their own awareness of the importance of exercise on mood and when needed, add exercise to their own personal routines.

Other implications for nursing practice include implementation of specific recommendations for exercise within treatment plans for persons with depression on both an inpatient and an outpatient basis. These recommendations would need to be individualized to meet the physical needs of each patient. The research found in this review supports supervised group aerobic exercise as the most consistently studied intervention. Nurses may choose to learn how to lead exercise groups or may educate themselves on available local resources for group exercise.

Many people today are reticent of pharmaceutical treatments for depression. Side effects of medication can be serious and sometimes permanent. In the event that a patient decides that they are not going to take antidepressants, nurses need all the resources they can get to help with the treatment of depression. Nurses generally recommend psychotherapy and this intervention is proven to be effective. This review shows that exercise is also effective, at least to some degree.
Nurses can now recommend that along with psychotherapy, patients establish an exercise regimen to both treat and prevent depression.
<table>
<thead>
<tr>
<th>No</th>
<th>Year</th>
<th>Author; Title; Journal, issue, vol, pg</th>
<th>Method/ Variables/ Instrument</th>
<th>Sample/ Characteristics</th>
<th>Results</th>
<th>Critique: Strengths Limitations</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2010</td>
<td>Perraton, L.G., Kumar, S., &amp; Machotka, Z. Exercise parameters in the treatment of clinical depression: a systematic review of randomized controlled trials...Journal of Evaluation in Clinical Practice16 (3), 597-604</td>
<td>Systematic review of randomized controlled trials (RCT). Supervised aerobic exercise. Variety of validated instruments used.</td>
<td>N=14 studies all with adults aged 18-65 with diagnosed clinical depression.</td>
<td>Aerobic exercise performed at 60-80% of maximum heart rate for 30 minutes 3 times per week for at least 8 weeks was effective and is recommended for inclusion of treatment plan.</td>
<td>Strengths: Conclusions include specific recommendations for best practices. Limits: Does not include studies with easier types of exercise or individual physical activity-only structured groups. Studies used different outcome measures. Allowed some studies with self-reporting.</td>
<td>I</td>
</tr>
<tr>
<td>2</td>
<td>2013</td>
<td>Cooney et al. Exercise for depression...Cochrane Database of Systematic Reviews 9, 487-498</td>
<td>Meta-analysis. Exercise as independent variable. Variety of validated instruments used.</td>
<td>N=39 RCTs with 2326 participants aged 18 and over.</td>
<td>Exercise is moderately effective at treating depression. Stricter controls produce results that show less significant difference.</td>
<td>Strengths: Strict research statistical methods employed. Limits: Many potential sources of bias including several studies with self-report tools. Wide variety of tools used for measuring depression.</td>
<td>I</td>
</tr>
<tr>
<td>3</td>
<td>2012</td>
<td>Leventhal, A. Relations between anhedonia and physical activity...American Journal of Health Behavior 36 (6), 860-872</td>
<td>Cross-sectional correlational study. Walking, moderate intensity physical activity, vigorous physical activity. Five different validated instruments for measuring anhedonia.</td>
<td>N=157 college students, 73% female, average age 19.9.</td>
<td>Inverse relationship between physical activity and anhedonia. Higher levels of anhedonia found with lower levels of physical activity. Gender testing showed no significant difference.</td>
<td>Strengths: Multiple validated tools produced similar results. Limits: Very limited sample population.</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>Authors</td>
<td>Title</td>
<td>Study Type</td>
<td>Sample Size</td>
<td>Results</td>
<td>Strengths</td>
</tr>
<tr>
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</tr>
<tr>
<td>4</td>
<td>2011</td>
<td>Eriksson &amp; Gard</td>
<td>Physical exercise and depression...Physical Therapy Reviews 16 (4), 261-268</td>
<td>Systematic review of RCTs. Supervised physical exercise as independent variable. Validated depression screening tools used in all studies.</td>
<td>N=8 studies with sample of 747 people from across the lifespan. Diagnosis of Major Depression required.</td>
<td>Mood improved regardless of type of exercise. Seven of eight studies showed significant improvement. One study specific to older adults showed improvement in mood with aerobic exercise.</td>
<td>All studies were RCTs. Crossed the lifespan. Limits: Difficult to measure effect of expectation of improvement vs. true physical cause for improvement.</td>
</tr>
<tr>
<td>5</td>
<td>2011</td>
<td>Krogh, Nordentoft, Sterne, &amp; Lawlor</td>
<td>The effect of exercise in clinically depressed adults: Systematic review and meta-analysis of randomized controlled trials...Journal of Clinical Psychiatry 72 (4), 529-538</td>
<td>Systematic review of RCTs. Supervised physical exercise, some aerobic, some non-aerobic, some with mixed types of exercise.</td>
<td>N=13 studies with sample of 584 adults (over 18) with diagnosed depression.</td>
<td>Exercise produced small short-term anti-depressant effect with no long term effect when intervention ends.</td>
<td>Included recent trials with stricter controls and better quality than some previous reviews. Limits: Paid for by pharmaceutical company, automatically introducing bias since pharmaceutical company would suffer if patient chooses exercise as sole intervention.</td>
</tr>
<tr>
<td>6</td>
<td>2012</td>
<td>Shomaker et al.</td>
<td>Depressive symptoms and cardiorespiratory fitness in obese adolescents...Journal of Adolescent Health 50 (1), 87-92</td>
<td>Cross-sectional correlational study. Pedaling stationary bicycle at 60-65 rpm. Children’s Depression Inventory, maximal cycle ergometry exercise test, dual energy x-ray absorptiometry testing.</td>
<td>N=103 obese adolescents in otherwise good health.</td>
<td>Association found between depressive symptoms and lower physical activity. Anhedonia correlated to poorer cardiorespiratory fitness. Negative mood correlated to poorer cardiorespiratory fitness.</td>
<td>Strong system used for measurement of cardiorespiratory fitness. Limits: All participants motivated for improvement as evidenced by desire to participate in weight loss program. Did not require official diagnosis of depression but relied on Children’s Depression Inventory.</td>
</tr>
<tr>
<td>ID</td>
<td>Year</td>
<td>Authors</td>
<td>Title</td>
<td>Study Design</td>
<td>Intervention</td>
<td>Sample Size</td>
<td>Findings</td>
</tr>
<tr>
<td>----</td>
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<td>--------------</td>
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</tr>
<tr>
<td>9</td>
<td>2013</td>
<td>Brunet et al.</td>
<td>The association between past and current physical activity and depressive symptoms in young adults: a 10-year prospective study...Annals of Epidemiology 23 (1), 25-30</td>
<td>Ongoing prospective cross-sectional longitudinal cohort study. Moderate to vigorous physical activity. Major Depression Inventory.</td>
<td>N=860 students from Montreal, Canada, ages 12-24.</td>
<td>Results show weak statistical evidence that supports an inverse relationship between moderate to vigorous physical activity at least 3 times per week and symptoms of depression.</td>
<td>Strengths: Large study with high quality statistical methods employed. Limits: Some aspects of data were self-reported. Focus was on quantity of exercise rather than quality of exercise.</td>
</tr>
<tr>
<td>10</td>
<td>2012</td>
<td>Gavric, Markovic, &amp; Cukafic</td>
<td>Correlation between levels of physical activity and the occurrence of depression among patients in family medicine clinics...European Journal of General Medicine 9 (2), 75-80</td>
<td>Correlational study. Moderate to vigorous physical activity. Patient Health Questionnaire (PHQ-9) and International Physical Activity Questionnaire (IPAQ).</td>
<td>N=141 adults aged 18-69, patients of family clinics in Bosnia.</td>
<td>Correlation found between low physical activity levels and depression. Moderate to vigorous activity for at least 2.5 hours per week was shown to decrease levels of depression.</td>
<td>Strengths: Well validated tools used for measurement of exercise and depression. Limits: More than half of participants scored low on PHQ-9 at onset of study limiting the usefulness of their information.</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>Study Title</td>
<td>Study Design</td>
<td>Study Population</td>
<td>Findings</td>
<td>Strengths</td>
<td>Limits</td>
</tr>
<tr>
<td>---</td>
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<td>----------------------------------------</td>
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<td>---------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>2010</td>
<td>Rothon et al. Physical activity and depressive symptoms in adolescents: a prospective study...BMC Medicine 32 (8), 174-183</td>
<td>Prospective cohort longitudinal cross-sectional study. Measured exercise at least vigorous enough to produce shortness of breath and/or perspiration. Short Moods and Feelings Questionnaire (SMFQ) and the Health Education Authority Survey (HEA).</td>
<td>N=2093 students aged 11-17 from East London schools.</td>
<td>Physical activity was shown to be inversely correlated with depressive symptoms.</td>
<td>Strengths: Large longitudinal study. International participation by researchers; British researchers gathered data while American statisticians compiled results. Limits: Use of self-reporting of amount and level of vigor of exercise.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2013</td>
<td>Loprinzi. Objectively measured light and moderate-to-vigorous physical activity is associated with lower depression levels among older U.S. adults...Aging and Mental Health 17 (7), 801-805</td>
<td>Controlled trial. Light and moderate-to-vigorous physical activity. Actigraph 7164 accelerometer worn for at least 4 days and Patient Health Questionnaire-9 (PHQ-9).</td>
<td>N=708 older adults, aged 65 and up with mean age of 73.5.</td>
<td>Objectively measured physical activity was inversely correlated with symptoms of depression in older adults.</td>
<td>Strengths: Objective measurement of exercise using accelerometer. National participation with ethnic diversity. Inclusion of covariates in calculations including chronic illnesses, age, gender, ethnicity, marital status and education. Limits: Participants were not required to be diagnosed with depression.</td>
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<td>13</td>
<td>2013</td>
<td>Brown, Pearson, Braithwaite, Brown, &amp; Biddle. Physical activity interventions in depression in children and adolescents...Sports Medicine 43 (3), 195-206</td>
<td>Systematic review of RCTs. Supervised physical activity introduced as intervention to increase health. Variety of validated tools for measurement of depression.</td>
<td>N=5 studies totaling 581 Australian children and adolescents ages 5-19.</td>
<td>Small significant overall effect using physical activity as an intervention for depression. More significant when used as part of a weight loss program.</td>
<td>Strengths: Study quality was addressed and low quality studies were not included. Limits: All studies were less than 3 months in length.</td>
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<td>14</td>
<td>2013</td>
<td>Gallegos-Carrillo et al.</td>
<td>Physical activity and reduced risk of depression: Results of a longitudinal study of Mexican adults... <em>Health Psychology</em> 32 (2), 609-615</td>
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<td>Prospective cohort longitudinal study. Aerobic exercise including walking, running, cycling, and swimming. Center for Epidemiologic Studies-Depression Scale (CES-D).</td>
<td>N=1,047 Mexican adults employed by the Mexican government participating in the Health Worker Cohort Study. Depression was higher among participants with low levels of exercise. Higher levels of exercise may provide some protection from symptoms of depression.</td>
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<td>Strengths: Tool used to measure depression was validated in Spanish. Six year study with large number of participants. Limits: Used only employed subjects. Tool for measuring physical activity was self-reported.</td>
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References


