Effects of Exercise in Children Suffering from Depression: A Review of the Literature from 2001-2007

TZIAMALI, V. & SIMONS, J.

Abstract

The purpose of this review is to evaluate the scientific evidence on the effects of exercise in children with depression.

Methods: Search was made in the Pubmed, CINAHL, ERIC, psycINFO and Sportdiscus from 2001 up to 2007. The selection criteria were studies written in English, with a population age up to 12 years old.

Results: Seven studies were found. One of them did not meet the inclusion criteria: the main age of the study group was more than 12 years old.

Finally, 6 studies were assessed: 2 correlation studies, 2 quasi-experimental design studies, 1 study control trial, not randomized study, and 1 RCT (Randomized Control Trial) study.

Conclusion: Exercise program has positive psychological effects on children with depression. Further investigation, however is needed in this field.

Key Words: depression, exercise programmes, children

Depression is one of the most severe types of illness during childhood (Tomson, Pangrazi, Friedman & Hutchison, 2003). It represents a significant and persistent public health problem and is related with many negative outcomes, including substance abuse, academic problems, cigarette smoking, high-risk sexual behavior, physical health problems, impaired social relationships, and a thirty-fold increased risk of completed suicide (Horowitz & Garber, 2006). According to National Institute of Mental Health 2000, up to 2.5% of children and 8.3% of adolescents experience major or minor depression (Tomson et al, 2003). Research shows that children who experience minor depression are in higher risk to experience a major depression (Tomson et al, 2003).

The American Psychiatric Association (DSM, 2000) places mood disorders into four categories: 1) depression, 2) bipolar or manic-depressive disorder, 3) mood disorders due to a medical condition and 4) substance-induced mood disorders (Tietjen-Smith & Ansel, 2007).

The treatment of depression in children is multi-modal, including individual psychotherapy, family therapy/education and pharmacological treatment (Nobile, Cataldo, Marino & Molteni, 2003).

Physical activity can play an important role in the prevention and treatment of depression (Tietjen-Smith & Ansel, 2007). Research indicates that regular exercise with an aerobic nature is associated with positive changes in psychological well-being and lower symptoms of depression (Crews, Lochbaum & Landers, 2004).

The purpose of this study is a literature review on the effects of aerobic exercise in children with depression.

Method

The literature search for the collection of the relevant studies was conducted in the following databases: PubMed, CINAHL, ERIC, psycINFO and Sportdiscus. Selection criteria included studies in which the effectiveness of intervention on depression in children up to 12 years old was described. The aforementioned searches were restricted to articles written in English with publication dates from 2001 to 2007. In order to achieve an efficient and sufficient collection of research articles, the search keywords were combined in groups of three, belonging in the subsequent categories:

- Population of the sample: children, child paediatric, youth
- Intervention method used: exercise, physical activity, physical fitness, physical exercise, leisure activity, aerobic exercise, running, walking, aerobic training, resistance training, strength training, sports, motor activity
- Pathology of the population: depression, mental health, dysthymia, mood disorders

Additional sources have been obtained from references reported in the articles. The selection of trials for inclusion in the review was performed independently by the two reviewers. Any discrepancies between the two reviewers was resolved by discussion.

Results

Seven studies were found using the search strategy above. One of them did not meet the inclusion criteria: the main age of the study group was more than 12 years old.
Finally, 6 studies were assessed: 2 correlation studies, 2 quasi-experimental design studies, 1 study control trial, not randomized study, and 1 RCT (Randomized Control Trial) study.
The results of the correlation studies are presented in the table 1.

Table 1
Results of the correlation studies

Study	Sample	Design and treatment	Assessment of depression	Assessment of physical activity
Tomson et al. (2003)	N = 933 (462 boys, 471 girls). Age range 9-12 yrs old.	4 groups divided by grade and sex	DDP	Questions
Parfitt & Eston (2005)	N = 70 (35 boys, 35 girls). Age range 9.8 to 11.4 yrs.old		STAIC, CDI, CY-PSPP	Use of pedometer

Childhood depressive Symptoms, Physical Activity and Health Related Fitness/Tomson, Pangrazi, Friedman & Hutchison/2003.
The aim of this study was to examine the relationship of being classified as physically active or inactive by a parent or a teacher to depressive symptoms in children 8 to 12 years of age. Participants were n = 933 children. Boys were 462 and girls were 471 from three Arizona schools in three districts.

The breakdown of the participants was done by grade and sex. In grade 3, there were 164 girls and 145 boys. In grade 4, there were 106 girls and 104 boys. In grade 5, there were 45 girls and 38 boys. In grade 6 there were 157 girls and 184 boys. Only children with a complete data set on all variables were included in the study. The depression assessment completed with the depression self report, the Dimensions of Depression Profile for Children and Adolescents (DDP), (Tomson et al, 2003). Children, who obtained a mean score of 2 or lower on all five subscales of the DDP, were classified as exhibiting the symptoms of major depression. Those, who obtained scores of 2 or lower on three of five subscales of the DDP, were classified as exhibiting the symptoms of minor depression. In order to obtain a global estimate of physical activity, three questions related to a given child's activity level were asked, one each of the parents, the teachers and the child. Parents and teachers were asked whether the child was physically active, while the child was asked if he or she played sports outside of school. Since parents and teachers are typically in contact with children at different times of the day and week, responses to these questions would not necessarily be highly related. The health related fitness assessment was completed through the assessment of two components. The Body composition, which was assessed using the body mass index (BMI), and the cardiovascular endurance, which was assessed with one mile run/walk. The main findings of this study, was that there is a strong association between depression and both the level of physical activity and health related fitness status. Of boys classified as by a parent as active, 5.6% also had depressive symptoms, while 19% of those classified as inactive had depression symptoms. As regard to the girls, 6.5% of active girls and 6.5% of inactive girls had symptoms of depression; these results were no significant. In contrast, 7% of active girls and 20% of inactive girls had depressive symptoms, resulting in a 2.8 times greater risk for depressive symptoms for those girls who classified as inactive. Relative risk of depression symptomatology for boys who did not play sports was 2.4 times higher than for those who did. Furthermore, the relative risk of depressive symptomatology is four times higher for boys not meeting the Fitnessgram criterion-referenced standard for BMI. As regard to the girls, the relative risk of depressive symptomatology was 2.8 times higher for girls not meeting the Fitnessgram criterion-referenced standard for BMI than for those who did.

Results of this study indicate an elevated risk for depressive symptomatology in inactive children and in those not meeting criterion-referenced standards for health related fitness. Concerning the presence of depressive symptoms, in this study they found significant differences between boys classified as active versus those classified as inactive by parents. Girls classified by a parent as active were not significantly different from girls classified as inactive. The prevalence of major depression was 48% for girls versus 65% for boys. The prevalence of minor depression was 8.4% for girls versus 6.3% for boys. Thus, more boys had signs of major depression while more girls had signs of minor depression.

The relationship between children's habitual activity level and psychosocial well-being/Parfitt & Eston/2005.

The aim of this study was to explore the relationship between habitual physical activity and psychological well-being in children.

Participants were n = 70, (35 boys and 35 girls) from three primary schools in North Wales. The children's ages ranged between 9.8 and 11.4 years old (mean age: 10.4 ± 0.4. yrs.). The inclusion criterion of this study was to complete the consent form. The assessment of physical activity completed using pedometers. They were sealed into a money belt worn by each child around the waist. They had to wear the money belt every day for 7 consecutive days from early in the morning until late at night. Each night the child's parents recorded the number of counts on the pedometer and re-set the pedometer to zero. The assessment of well-being completed using three questionnaires: the state-trait Anxiety Inventory for Children (STAIC), (Spielberger, Edwards, Lushene, Montuori & Platzek, 1973) the Childhood Depression Inventory (CDI) (Kovacs & Beck, 1977) and the Children and Youth's Physical Self-perception Profile (CY-PSPP) (Whitehead, 1995). The results of this study demonstrated that activity was significantly ($p < 0.001$) and negatively related to anxiety ($r = -0.48$) and depression ($r = -0.60$), and positively related to global self-esteem ($r = 0.66$).

The results of the 2 quasi-experimental design studies are presented in the table 2.

Table 2
Results of the quasi-experimental design studies

Study	Sample	Design and treatment	Assessment of depression	Assessment of physical activity
Annesi (2004)	N = 54 (28 girls and 26 boys) Age range 9-12 yrs old.	3 or 4 cardiovascular activities/ 3 times/week / 45 min. 2 times/week resistant training 1 day/week sessions on goal setting, facilitative self-talk, recruiting social support and other behavioural strategies. Twelve weeks.	The profile of mood States – Short form scales of Tension and Depression.	10 item self-report: Exercise Self efficacy scale for Children
Hodge (2003)	N = 20 (3 female, 17 male). Age range 7 to 12 yrs old.	Baseline program (no exercise), exercise intervention, Baseline program (no exercise), exercise intervention.	Mood self rating scale, Teacher rating scale, Children's Depression Inventory, Child Behaviour Checklist, Teacher Report form	Half mile walk/run test, Self Mastery Scale, Daily life Stressors scale.

Relationship between self-efficacy and changes in rated tension and depression for 9 to 12 yr. old children enrolled in a 12 week after school physical activity program/Annesi/2004.
The purpose of this preliminary analysis was to test for significant inverse relations between changes in scores on the Exercise Self-efficacy Scale for Children (Annesi, Westcott, Faigenbaum & Unruh, 2005) and changes in the Tension and Depression scale scores on the Profile of Mood States (McNair, Lorr & Droppleman, 1992) for children in a physical activity. Participants were n = 54 (28 girls and 26 boys) ages 9 to 12 years old (M age = 10.1 yr, SD = 1.0 yr). They were 93% African American in the lower to middle socioeconomic strata. They were enrolled in a 12 week after-school physical activity program; 3 times per week for 45 min. Three of four cardiovascular activities were administered each session which alternated between low (50%-60% heart rate), medium (60%-70% heart rate) and high (70%-85% heart rate). Resistance exercises were completed two days per week. One day per week, sessions on goal setting, facilitative self-talk, recruiting social support and other behavioural strategies were provided. Tension and depression were assessed on the Profile of Mood States-Short Form scales of Tension and Depression of five items each (McNair, Lorr & Droppleman, 1992). Exercise self-efficacy was assessed through a 10-item self-reports entitled the Exercise Self-efficacy Scale for Children (Annesi, Westcott, Faigenbaum & Unruh, 2005). Changes in rated Tension, Depression, and Exercise Self-efficacy were calculated by subtracting each participant's score at Week 1 from the score at Week 12. The results of this study proved showed, that correlations were significant and negative between participant's changes in Exercise Self-efficacy Scale for Children scores and changes in Tension ($r = -.44$, $p = .001$) and Depression ($r = -.33$, $p = .01$) scores. Analysis yielded an inverse correlation between changes in Exercise Self-efficacy and Tension and Depression over 12 week of a physical activity program.
The effects of exercise on depressed mood in prepubertal children/Hodge/2003.
In this study the hypothesis is tested that an aerobic exercise intervention would improve mood, depressive symptoms and depression-related behavior in a clinical child population.

Participants were 20 (3 female, 17 male) day treatment students, ranging in age from 7 to 12 years old. In this study all participants were asked to participate in a baseline (no exercise) phase and an exercise intervention phase, followed by a return to baseline phase and a final exercise phase. At the end of each phase, participants completed a series of measures designed to assess daily mood (Mood Self-Rating Scale, Teacher-Rating Scale), depressive symptoms (Children's Depression Inventory), and depression-related behavior (Child Behavior Checklist, Teacher Report Form). Potential underlying mechanisms were also measured after each phase (Half-Mile Run/Walk Test, Self-Mastery Scale, and Daily Life Stressors Scale). The significant result found was that self-reported daily mood continued to improve once exercise was withdrawn, and then worsened after exercise was reintroduced.
The results of the 1 study control trial, not randomized study are represented in the table 3.

Table 3
Results of the study control trial not randomized study

Study	Sample	Design and treatment	Assessment of depression	Assessment of physical activity
Annesi (2005)	N = 90 (study group = 23 boys and 26 girls) (control group = 23 boys and 26 girls) Age range 9-12 yrs old.	*Study Group*: physical activity program: 3 days/week, cardiovascular activities, five or six resistance exercises. 45 min. per session *Control group*: This group focused on homework completion, reading and tutoring. Twelve weeks.	The profile of Mood States-Short form scales of Depression and total mood disturbance.	Suggestions from the recall of research on physical activity and required participants to recall how many days in a week was completed for a total 30 min. or more.

Correlations of depression and total mood disturbance with physical activity and self-concept in preadolescents enrolled in an after-school exercise program/Annesi/2005.
Participants Participants were total n = 90. In the study group there were n = 49 (girls n = 26 and boys n = 23). In the control group there were n = 41 and the proportion of boys and girls were similar to the study group. The age range was 9-12 yrs old (M age = 10, 5 S.D = 0, 9). Only children with complete data were included as participants. Approximately 51% were African American, 41% Euro-American and 8% of other racial groups. The control group concentrated mostly on homework completion, reading, and tutoring but planned to incorporate physical activity later. In addition to similar academic tasks, the treatment group completed a structured physical activity program in a multipurpose room led by one or two trained counselors. The physical activity program included 3 days per week of cardiovascular activities in the form of non-competitive tasks and games which alternated among low (55% heart rate), medium (65% heart rate) and high (80% heart rate) intensity. Participants completed assessments during Week 1 and Week 12 of the program.
Depression and overall negative mood were assessed on the Profile of Mood States-Short Form scales of depression (5 items) and Total Mood Disturbance (30 items) (McNair, Lorr & Droppleman, 1992). Self-concept was assessed on Self-description Questionnaire-I-General Self scale (Marsh, 1990). The physical activity assessment followed suggestions from the recall of research on physical activity and required participants to recall how many days (0 to 7) in a typical week moderate-to-vigorous exercise was completed for a total of 30 min. or more. The

results of this study proved significant associations between recalled number of days physically active per week and Body Mass Index ($p = .25$) and time to complete a 1 mile (1.6 km) run ($p = .33$). Girls did not report significantly fewer days being physically active per week than boys. No significant differences were found for scores on the psychological tests either. No statistically significant difference was found between control and treatment groups on Depression ($t\ 88 = 0.15$ns) or Total Mood Disturbance ($t\ 88 = 0.26$, ns) at Week 1. These preliminary analyses indicated that the correlation between Depression scores and both General Self scores and reported days of physical activity were significant. Correlations between Total Mood Disturbance and both General Self and days of physical activity were also significant. General self scores and days of physical activity were positively correlated but not statistically significant. For the control group, no significant changes on Depression or Total Mood Disturbance scores were found from Week 1 to Week 12. For the physical activity treatment group, a significant reduction over 12 weeks was found on Depression. Reduction on Total Mood Disturbance was not significant. Mean differences in participants Depression and Total Mood Disturbance scores from Week 1 to Week 12 differed significantly between the control and treatment groups. On both scales, the reduction was greater for the treatment group.
The results of the RCT (Randomized Control Trial) study are represented in the table 4.

Table 4
Results of the RCT (Randomized Control Trial) study

Study	Sample	Design and treatment	Assessment of depression	Assessment of physical activity
Crews et al. (2004)	N = 66 (33 girls and 33 boys) Age range 9-12 yrs old.	Aerobic exercise group (Girls = 18, Boys = 33), Aerobic exercise, 3 times/week 20 min. Physical activity control group (Girls = 17, Boys = 15), physical activity such as: shooting baskets, Playing game, and walking. Six weeks.	The trait anxiety inventory for children, Beck Depression Inventory for children, Rosenberg's scale	PWC 170 Test

Aerobic Physical Activity Effects on Psychological well-being in low-income Hispanic Children/Crews, Lochbaum & Landers/2004.
For this study, 66 Hispanic students (33 girls, 33 boys) in Grade 4 from two schools in low-income districts met all study criteria. The aerobic exercise group (18 girls, 16 boys) participated in three times per week for 20 min. maintaining a mean training heart rate of 160 bpm. The physical activity control group (17 girls, 15 boys) participated in three times per week for 20 min. maintaining a mean training heart rate of 134 bpm. The students completed the pre-intervention battery of physiological/anthropometric and psychological measures and then they were randomly assigned to the Aerobic Exercise group or to the Control group. The activities were stationary cycling, track running, and jumping on a mini trampoline. The activities in the control group were shooting baskets for skill improvement, children's game called four-square and walking. The average heart rate of 135 bpm was at the lowest end of the range for 50% of maximum heart rate reserve.
The psychological and anthropometric measures were assessed. The Aerobic fitness was assessed before and after the program using the PWC170 test (Astrand & Rodahl, 1970). The children cycled for 3 min. stages on a Monark cycle with a resistance at 25 or 50 kg at the be-

ginning and increased until the participants reached a heart rate of 170 bpm. In order to assess the psychological measures, the children completed a questionnaire. Trait anxiety was assessed using the Spielberger, Gorsuch, Lushene, Vagg, and Jacobs' Trait Anxiety Inventory for Children (1983). Depression was assessed by the Beck Depression Inventory (1967). Rosenberg's scale (1979) was used to assess self-esteem. Preliminary analysis yielded no significant ($p < .05$) main effects for sex or interaction of sex by group on the pretest means for any of the measured variables, while significant main effects ($p < .05$) were found only for depression and trait anxiety. There was found a significant difference in kilograms required for the attainment of a heart rate equal to or greater than 170 bpm for the Aerobic group from the pre- to post-test, while the change in the Control group's fitness was not significant. A significant main effect for group was found for self-esteem.

Discussion

The results of both correlation studies support that there is a significant negative correlation between exercise and depression. In the first study, the results indicate an elevated risk for depressive symptomatology in inactive children and in those not meeting criterion-referenced standards for health related fitness. In the second study, the results generally indicate that only global self-esteem is uniquely related to physically activity levels. However, anxiety, depression and global self-esteem are highly intercorrelated (anxiety and depression $r = 0.68$, anxiety and self-esteem $r = 0.71$, and depression and self-esteem $r = 0.80$). The weakness of this study is the inability to precisely discuss the intensity of the physical activity that the children engaged in over the 7 days.

As regard to the quasi-experimental design studies, the first proved significant changes over 12 weeks on all three psychological factors. Correlations were also significant and negative between participants changes in Exercise Self-efficacy Scale for Children scores and changes in Tension ($r = -.44$, $p = .001$) and Depression ($r = -.33$, $p = .01$) scores. The second study did not provide clear support for the positive effects of structured exercise on mood state. Limitations of this study, such as lack of power, measurement issues, environmental factors, and population characteristics are addressed.

The study control trial, not randomized study proved that participation in the 12-week exercise program was associated with significant reductions on both Depression and Total Mood Disturbance scores. It is possible that improvements in mood may be associated with self-concept and other perceptions of the self. Also, physical activity is consistent with self concept. This suggests further research on the use of tenets of social cognitive and self-efficacy theory.

In the Randomized Control Trial (RCT) study, the results point out a significant post-test difference ($p < .05$) for depression, with the adjusted means indicating that participants in the Aerobic group reported less depression. The results support the hypothesis that aerobic physical activity is associated with the improvements in psychological well-being.

Previous researches relevant to this indicated that aerobic exercise gave a significant decrease in depression. This claim is common to this study. However, previous studies focused on children and young people aged 0 to 20, while this study focus on children until 12 years old.

Also, there is insufficient evidence to say whether aerobic or weight training is the best way to exercise as the evidence for children is scarce. The field needs to be further investigated by well-designed randomized controlled trials.

The results of this literature review indicate that this topic require further research.

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Author's notes

Tziamali V.
M.Sc.
Katholieke Universiteit Leuven
Leuven, Belgium

Simons Johan
Ph.D, PT, PMT
Katholieke Universiteit Leuven
Leuven, Belgium

Send correspondence to:
Simons Johan, Ph.D., P.T., PMT
FaBeR
Katholieke Universiteit Leuven
Tervuursevest 101
3001 Heverlee
Leuven, Belgium
T. 016 32 91 40
Johan.Simons@faber.kuleuven.be