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INVESTIGATING THE IMPACT OF SWIMMING AND COMPLEX SPORT THERAPY ON ANXIETY EXPERIENCED BY CHILDREN WITH SPINAL COLUMN DISORDERS AND ASTHMA

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ABSTRACT

Asthma is the most common chronic medical condition in children and a common reason for hospitalization (Beggs et al., 2013). Functional spinal column disorders (FSCD) characterized by a deviated spinal curvature can impair musculoskeletal development. Both medical conditions have a strong impact on children's wellbeing through restriction of peer interaction and daily activity attendance. Decreased social functioning and limited interaction prevent skill development and are associated with the development of performance and social anxiety. Involvement in physical activity programs increases fitness, coordination and strength. The effect of physical exercise on the medical condition is well documented, but quality of life is less investigated in the literature. The major aim of the present study was to demonstrate that aside from improving physical fitness, sport therapy (swimming training and complex sport therapy) improves children's quality of life by reducing anxiety symptomatology in both asthma and other chronic conditions (FSCD) compared to normally developing peers. Hungarian children aged 8-11 years with FSCD and/or asthma that participated in swimming training or complex sport therapy for 18 months showed a decrease in self-reported anxiety compared to matched controls. Our findings support the use of swimming and complex sport therapy in the improvement of children's quality of life through reduction of anxiety symptoms.

KEYWORDS: *functional spinal column disorders, asthma, anxiety, swimming, complex sport therapy*

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INTRODUCTION

Although engaging in regular physical activity is widely accepted as an effective preventive measure for a variety of health risk factors across a wide range of age groups, involvement in physical activity remains low, especially in children and adolescents (Trembla et al., 2011). Many sources, including the Health Behavior in School-age Children Survey (HBSC) indicate that children and adolescents spend the majority of their leisure time engaging in sedentary pursuits (Currie, 2008). For example, in Hungary, according to HBSC 2010 (Currie, Zanotti, & Morgan, 2012) over 50% of 11 year olds reported watching TV (and DVD) for two or more hours daily during weekdays and over 33% reported playing games on the computer or on consoles for more than two hours per day during weekdays. Physical inactivity and engagement in a wide variety of sedentary behaviors is associated with obesity, cardio-vascular disease and musculoskeletal development pathology.

Functional spinal column disorders (FSCD) are characterized by spinal curvatures and deformity that affect musculoskeletal development in children and adolescents leading to pain, changes in posture and an impairment of daily activity attendance. Irrespective the factors that trigger its appearance, a sustained impostural balance can result over time in establishment of a state of continuous asymmetric loading relative to the spinal axis (Hawes & O'Brien, 2006). Therefore, children that have low levels of physical activity (i.e., lower muscular use and development) and high levels of sedentary behavior such as sitting in front of the TV or the computer are at high risk for developing various types of spinal deformities according to the angle of the load on the spinal column. Recent studies support the longstanding hypothesis that spinal deformity results directly from such postural imbalance, irrespective of the primary trigger, because the dynamics of growth with vertebrae are altered by continuous asymmetric mechanical load (Hawes & O'Brien, 2006). In Hungary, spinal curvatures in children are routinely diagnosed during early stages and children are recommended through parents to take part to free of charge sports activities, like swimming therapy.

Although engagement in regular physical activity programs, for children with health related needs or their healthy peers, leads to an increase in fitness, strength, coordination, and balance, little is known about the impact that such programs have on children's emotional development and well-being.

Aside from sedentary behavior, multiple epidemiological studies from around the world indicate that the prevalence of asthma among children and adolescents is rising (Wong & Chow, 2008). Many children with asthma have decreased quality of life, poor physical fitness and are physically inactive (Weisgerber et al., 2008). Asthma is a disease associated with the chronic inflammation of the airways which triggers a hyper-reactive response that results in obstruction of the air flow and is manifested by coughing, wheezing, chest tightness and shortness of breath (Beggs et al., 2013). As many asthmatic children who

engaged in school and playground physical activities were affected by exercise-induced bronchospasm, parents and physicians were previously reluctant about allowing children to engage in systematic physical exercise (Szentagothai, Gyene, Szocska, & Osvath, 1987). These concerns referred mostly to the worry that physical exercise can worsen asthma symptoms may reduce participation and result in reduced physical fitness (Beggs et al., 2013). Because of previous experience with symptomatology, children with asthma, and also their parents, live under constant pressure in expectation of future asthma attacks.

Subjects with asthma have a unique response to physical activity. On the one hand, exercise can provoke an increase in airways resistance, leading to exercise-induced asthma attacks. On the other hand, regular physical activity and participation in sports are considered to be useful in the management of asthma, especially in children and adolescents, but this has not been investigated in the same detail as the mechanism underlying exercise induced asthma attacks (Ram, Robinson, Black, & Picot, 2000). The use of physical exercise as an intervention aimed at reducing wheezing and asthma attacks was first mentioned over 60 years ago; still, a history of asthma has most often resulted in neglecting physical exercise classes in school and being exempted from sport activities (Szentagothai et al, 1987).

During childhood and adolescence asthmatic individuals seem to have physical activity levels comparable with those of the normal pediatric population. However, differences in physical activity levels may develop during the time of maturation from adolescence into adulthood (Welsh, Roberts, & Kemp, 2004). Hypoactivity of asthmatic children results in poor physical fitness, which further deteriorates their health. Several studies in children with asthma have demonstrated that physical exercise does improve aerobic fitness as well as reduce episodes of wheezing, hospitalizations, school absenteeism and sometimes medication usage (Welsh, Kemp, & Roberts, 2005). Physical training programs have been designed for patients with asthma with the aim of improving physical fitness, neuromuscular coordination and self-confidence (Ram, Robinson, & Black, 2000). Several conclusions can be drawn from these programs: first, in spite of the possibility of exercise-induced bronchospasm, asthma is not a contraindication against participation in sports, as regular exercise has its therapeutic value; second, it was shown that sport-related activities can be ranked according to their asthmatic attack-inducing capabilities, and swimming proved to be the least attack-inducing; third, it was recognized that although physical training does not change the basic asthmatic condition, it does improve physical fitness, develop skills and can help the child to cope with disease and its emotional consequences (Szentagothai et al., 1987). Swimming is more indicated for asthmatic patients as the air above the pool is warmer and humidified, there is low pollen exposure, respiratory effort is reduced by hydrostatic pressure and there is a relative hypoventilation due to controlled breathing. These are on top of the physiological effects of any physical training,

such as increased self-esteem, self-confidence and improved cardio-pulmonary fitness (Beggs et al., 2013).

Without interventions aiming physical activity, children affected by high levels of inactivity would be doubly disadvantaged as their asthma is likely to be poorly controlled and their prospects for a healthy adult life reduced (Welsh et al., 2004). Physical activity is especially important in children with asthma. Activities such as running and swimming are associated with improved fitness and decreased severity of asthma symptoms (Lang, Butz, Duggan, & Serwint, 2004). Prior studies of exercise programs in asthmatic children suggest potential benefits such as improved fitness, decreased school absences, hospitalizations, symptom days and inhaled corticosteroid need along with improved quality of life (Weisgerber et al., 2008). Swimming training is well tolerated in children and adolescents with stable asthma, and simultaneously increases physical fitness and lung function.

Perhaps the strongest impact asthma and other chronic medical conditions can have on a child's wellbeing and ability to mix with their peers is through restriction of daily activity (Price, 2001). Researchers' interest in the association between asthma and anxiety stems from the overlapping symptoms that these conditions share, such as: sensations of being smothered, choking, hyperventilation–induced dyspnea, increased anxiety and the resemblance between asthma attacks and panic attacks (Katon, Richardson, Lozano, & McCauley, 2004). As the physiological activation in panic attacks is experienced because of asthma, children and adolescents interpret such experiences in a catastrophic manner and in time, previous asthma attacks become panic attacks, and can be triggered by fewer symptoms as fear of a new attack increases focus on the symptomatology that is now coupled with dysfunctional cognitive interpretations. Generally, cognitive explanations posit that longitudinal experience with respiratory disease such as asthma may generate fearful or catastrophic beliefs about respiratory symptoms, which, in turn, provoke panic attacks (Katon et al., 2004).

Experiencing asthma symptoms may be accompanied by appearing visibly distressed or taking medication in front of friends, which may elevate fears associated with social evaluation (Bruzzese, Fisher, Lemp, & Warner, 2009). It is known that adolescents often feel embarrassed about their condition and fear taking medication (i.e., using inhalants) in front of their peers (Cohen et al., 2003). Social anxiety, one of the most common types of anxiety in adolescence, is characterized by intense fear of social or performance situations and distress or avoidance that leads to significant impairments like loneliness, few friends, depressed mood, disturbances in school performance and difficulty with interpersonal relationships (Bruzzese et al., 2009). More specifically, children with asthma reported more generalized discomfort and inhibition in social situations than their peers and feared being negatively viewed by others when experiencing current symptoms.

Although swimming and complex sport therapies are known to improve fitness and neuromuscular coordination, it is less documented whether quality of

life improves during or after such interventions. Both FSCD and asthma can impair children in their daily functioning, by restricting attendance to activities, which leads to less opportunity to build social relations and develop mastery in various domains, and by being a trigger for social evaluation and perceived inadequacy compared to peers. Therefore, the major aim of the present study was to demonstrate that aside from improving physical fitness, sport therapy (swimming training and complex sport therapy) improves children's quality of life by reducing anxiety symptomatology in both asthma and other chronic conditions (FSCD) compared to normally developing peers. As the secondary symptomatology of the medical conditions is a key factor in the development of anxiety in children, we hypothesized that swimming training and complex sport therapy will affect children's quality of life through a reduction of anxiety symptomatology compared to matched control groups.

Participants

A total of 82 children aged 8-11 years took part in the current study in one of the four research groups. There were two intervention groups and two matched control groups. Mean age for the intervention group was 9.85 years, with a standard deviation of .85, and for the control group 9.79 years and a standard deviation of 1.06 years. In both intervention and control groups boys represented 46%. The first intervention group (G1) consisted of 26 students with FSCD that attended swimming training for 18 months. This group had a matched control group for age, gender and BMI (G1c) of 26 students with regular development. The second intervention group (G2) consisted of 15 students with FSCD and asthma that attended complex sports therapy for 18 months. This group also had a matched for age, gender and BMI control group (G2C) of 15 students with regular development. The control groups did not receive organized sports activities during the 18 months of intervention.

Procedure

Two intervention groups (FSCD and FSCD with asthma) received swimming training or complex sport therapy for 18 months, while the participants in the matched control groups did not receive any type of active intervention. Children in the control groups were selected as to match for gender, age, BMI, and low levels of physical activity. Swimming training consisted of two weekly swimming sessions of 60 minutes for 18 months. Complex sport therapy consisted of two weekly swimming sessions of 60 minutes, one weekly 60 minute session of indoor sports and one 60 minute session of outdoor sports. The above mentioned characteristics are synthesized in the table below.

Table 1.
Intervention groups and their characteristics

Intervention group	Participants	Intervention characteristics	Duration
G1 - FSCD	N=26	2 x 60' swimming sessions / week (backstroke)	18 months
G2 – FSCD asthma	N=15	2 x 60' swimming sessions / week (front and back stroke, speed competitions) 1 x 60' indoor physical activity (cardiovascular engagement) 1 x 60' outdoor physical activity (running, cycling, skiing)	18 months

Children completed anxiety self-report measures at the beginning of the intervention program, and 18 months later at the end of the intervention program. Parents agreed to their children's participation in the intervention program and the evaluation of anxiety before and after the program. Children that took part in the study had maximal attendance rate to the program activities during the 18 months. The children in the matched control groups completed measures at the same time as their peers, but did not receive any active intervention and they did not engage in systematic physical activity during the 18 months.

Measures

State trait anxiety inventory for children (Spielberger 1973; STAI-C adapted for Hungarian children by Spielberger & Sipos, 1978; Sipos & Sipos, 1979).
STAI-C is the leading self-administered anxiety measure for elementary school children. The inventory distinguishes between anxiety as a stable personality trait and state anxiety in relation to a present context. It is composed of two separate self-report scales for measuring state or trait anxiety. Higher scores are positively correlated with higher levels of anxiety. This form applies a 3-point Likert scale for each item (1-rarely, 2-sometimes, 3-often). Reliability indicators for this specific population recommend its usage.

Social anxiety scale for children (SASC – H, adapted for Hungarian children by Sipos & Rákos, 1991)
This scale measures social anxiety in children according to three different aspects of the condition: social anxiety/distress in new situations (6 items), fear of negative evaluation (8 items) and social anxiety/distress in general (4 items). It consists of a total of 18 items rated on a 5-point Likert scale.

Test anxiety inventory (TAI adapted for Hungarian children by Sipos, Sipos, & Spielberger, 1988)
This inventory was developed to measure the individual difference in test anxiety, as a situation specific personality trait. In responding to this 20 item self-report scale, students are asked how frequently they experience specific anxiety (worry and emotionality) symptoms before, during or after examinations.

RESULTS

First of all, we investigated the internal consistency (calculated Cronbach's alpha) of the self-report instruments mentioned above in relation to the present sample of participants compared to that of the original samples for the Hungarian population. Results are shown in Table 2.

Table 2.
Descriptive data regarding the self-report measures used in the present study.

Present study	**STAIC-state**	**STAIC-trait**	**TAI - total**	**SASC-N.E**	**SASC-in new situations**	**SASC-SA&D**
Mean and standard deviation, M and SD	M=30.46 SD=5.72	M=30.28 SD=6.05	M=36.83 SD=10.81	M=19.07 SD=5.44	M=15.25 SD=4.21	M=7.06 SD=2.5
Internal consistency, Cronbach's α	α = .881	α = .86	α = .92	α =.752	α = .68	α = .57

Second, because the normality assumption was not met and there was a small number of participants in each condition, we used non-parametric tests to examine the differences between intervention and control groups at baseline and after the intervention.

There were no significant initial differences regarding self-reported anxiety between the intervention and control groups as indicated in Table 3.

Table 3.
Results of the Mann-Whitney test for G1 and G1c at baseline and post-intervention.

	STAIC-state	**STAIC-trait**	**TAI - total**	**SASC- in new situations**	**SASC-N.E**	**SASC-in general**
Pre-intervention (G1-G1c)	Z=1.024 *p*=.305	Z=0.851 *p*=0.394	Z=0.466 *p*=0.640	Z= -0.216 *p*=0.828	Z=0.338 *p*=0.734	Z= -0.768 *p*= 0.442
Post-intervention (G1-G1c)	Z= -0.109 *p*=0.913	Z= -0.539 *p*=0.589	Z= -0.594 *p*=0.552	Z= -1.070 *p*=0.284	Z= -0.924 *p*= 0.355	Z= -0.530 *p*= 0.565

The Wilcoxon test indicated that trait anxiety (**STAIC-trait**) was significantly higher in the first intervention group at baseline than at the end of the intervention Z=2.542, $p<0.01$, $r=0.35$. Test anxiety (**TAI-total**) was significantly higher in the first intervention group at baseline than at the end of the intervention Z=2.362, $p<0.01$, $r=0.33$. Also, the fear of negative evaluation (**SASC- N.E**) decreased in the first intervention group at the end of the intervention Z=2.973, $p<0.003$, $r=0.41$. There were no significant differences in anxiety for the paired control group (G1c) between baseline and the end of the intervention.

Regarding the second intervention group, although there were no significant differences in self-reported anxiety at baseline, there were significant differences after the intervention for all the measures as shown in Table 4.

Table 4.
Results of the Mann-Whitney test for G2 and G2c at post-intervention.

	STAIC-state	**STAIC-trait**	**TAI total**	**SASC-N.E.**	**SASC-new situations**	**SASC-in general**
Post-intervention (G2-G2c)	Z= -2.571 *p*<0.01 *r*=0.47	Z= -3.878 *p*<0.01 *r*=0.71	Z= -2.219 *p*<0.03 *r*=0.40	Z= -2.073 *p*<0.04 *r*=0.38	Z= -2.343 *p*<0.02 *r*=0.43	Z= -2.385 *p*<0.02 *r*=0.44

Between the two intervention groups there were significant differences, although both intervention groups showed a significant reduction in general and social anxiety at the end of the intervention, the complex sport therapy group reported less anxiety symptomatology than the other intervention group as presented in Table 5.

Table 5.
Results of the Mann-Whitney test for G1 and G2 at post-intervention.

	STAIC-state	**STAIC-trait**	**TAI - total**	**SASC- N.E**	**SASC-in new situations**	**SASC- in general**
Post – intervention (G1-G2)	Z= -2.043 p<0.04 r=0.16	Z= -2.652 p<0.001 r=0.41	Z= -2.002 p<0.004 r=0.31	Z= -2.571 p<0.01 r=0.40	Z= -3.004 p<0.001 r=0.47	Z= -1.651 p<0.09 r=0.26

DISCUSSION

Asthma is the most common chronic medical condition in children and a common reason for hospitalization (Beggs et al., 2013). According to Price (2001), all types of activity can be an important trigger of asthma at all stages of childhood. Asthmatic subjects often have worsening symptoms when they exercise and this can prevent them from exercising and attempting to keep fit (Ram et al., 2005). Cough and wheezing interferes with sport and other forms of physical activity in half of asthmatic children. Airway obstruction can be induced by a standard exercise test in over 70% of children with asthma (Price, 2001). Although many factors are necessary for asthma development, there is a growing body of literature that implicated lifestyle change, specifically decreased physical activity, as a contributor to the increase in asthma prevalence and severity (Lucas et al., 2005). Physical training programs have been designed for asthmatic subjects with the aim of improving physical fitness, neuromuscular coordination and self-confidence. Both asthma and anxiety disorders have a high prevalence in child, adolescent and adult populations, and increasing evidence suggests that these disorders frequently co-occur (Katon et al., 2004). According to Bruzzese and collaborators (2009), adolescents with asthma report feeling different and isolated from their peers, fear peer rejection and have poor social competence. They report being teased, fearing peer rejection and feeling isolated because of their illness, which may account for an increase in social anxiety, particularly fear of being negatively evaluated by peers and distress in social situations. Moreover, their ability to identify and relate to peers may be hampered when asthma leads to impairment in physical or social activities thereby reducing the opportunity for social interaction. As the previously mentioned authors conclude, social anxiety may be particularly disabling during adolescence because peers play a critical role in social and identity development during this period.

Functional spinal column disorders (FSCD) are characterized by spinal curvatures and deformity that affect musculoskeletal development in children and adolescents leading to pain, changes in posture and an impairment of daily general

activity attendance. Although the subjective perceptions of children that suffer from FSCD have not yet been investigated, we can assume that because of postural deformities that affect children's self-image, making them different from others, and by limiting their daily activities, the subjective effects of the medical condition can be similar to those of the asthmatic children that also feel different and restricted in interaction.

Our aim was to demonstrate that involvement in regular physical activity programs has a significant impact on children's emotional development and well-being, not only on the physical development and that there is psychological improvement, not only a physiological improvement leading to a relief in the medical condition. We do not yet know which is the mechanism by which physical activity programs influence emotional states, especially anxiety in children, whether there is a direct effect or the amelioration of the medical condition leads to an improvement in the emotional state, but we now know there is a significant effect of these programs on the emotional dimension as well.

Children that are limited in their daily activity by medical conditions report being teased, fearing peer rejection and feeling isolated because of their illness, which may account for an increase in social anxiety, particularly fear of being negatively evaluated by peers and distress in social situations. Although both intervention programs proved to have an impact on anxiety reduction in participating children, complex sport therapy proved to be significantly better than the swimming training alone, indicating that more complex activities lead to better results in this area. Both general anxiety and social anxiety decreased in the intervention groups proving that engagement in physical activity programs has both physical and psychological benefits for children. Of course, not all types of physical activity are recommended for children with FSCD and/or asthma but compared to swimming alone, complex sport programs that include swimming, as well as in- and out-door activities proved to be more efficient. Because both interventions relied on swimming as a type of physical activity we cannot conclude weather the different activities in the complex sport program contributed more, or the effect was due to the longer time that children were engaged in physical activity (2h/week – G1 compared to 4h/week – G2).

The 2013 Chochrane Review on swimming training for asthma indicates that physical fitness increases with swimming training compared with usual care, but no effects were found on quality of life. The present study was designed to investigate the effects on quality of life, especially emotional improvements due to anxiety reduction, and both swimming therapy, and complex sport therapy, proved to have such significant effects, on both children suffering from asthma and FSCD alone.

In light of the present findings, we can conclude that although further investigation is needed, our results set the stage and encourage other scientists to investigate the psychological effects of physical activity programs besides the physical and medical effects that these interventions are known to have.

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