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ASTHMA IN CHILDREN

Risk Factors and Their Effects on the Comorbidity of

Asthma and Anxiety Disorders in School Aged Children

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Abstract

Asthma is the most common chronic childhood disease, characterized by attacks that make a child or adult feel like they are unable to breathe (Shohat, Graif, & Garty, 2005). Currently, nearly 6.3 million children between the ages of 5 and 14 are afflicted with asthma (EPA, 2006)

Children with asthma are also more prone to developing other disorders especially, anxiety. The prevalence of child patients with asthma suffering from anxiety disorders is found to be as high as 4.7% (Katon, Richardson, Lozano & McCauley, 2004). The current study aims to examine the risk factors that contribute to the comorbidity of asthma and anxiety in pediatric patients.

Several risk factors can lend themselves to this comorbidity and it is hypothesized that there are four prevalent ones. The risk factors were drawn from the biological, environmental, and familial domains. They include asthma severity levels, socioeconomic status, amount of stress in the family and parent mental health.

There were five main measures used in the study. The Functional Severity Scale determined asthma severity. Socioeconomic status was determined by using the Hollingshead Index. Parent mental health status was assessed through the Brief Symptom Inventory (BSI) and family stress levels through the Family Inventory of Life Events (FILE). The primary caregiver completed all four measures during their lab visit.

Participants ranged between 8-12 years of age along with their primary caregivers. Ninety-three percent of the primary caregivers were mothers. They were drawn from a sample pool from the Family Life and Asthma Project, an on-going study based in Syracuse, New York. Seventy-two families were selected based on which children completed the Multidimensional Anxiety Scale for Children (MASC), a measure of childhood anxiety.

Overall, it was found that family stress levels, socioeconomic status, and the severity of the child's asthma all had significant effects on child anxiety levels. The only factor that did not have a significant effect was the level of parent depression or anxiety.

When the risk factors were looked at as one combined risk factor, levels of anxiety rose with the presence of zero, one, or two risk factors. However, when children had three, four, or five risk factors in their lives, anxiety increased and decreased inconsistently.

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Risk Factors and Their Effects on the Comorbidity of

Asthma and Anxiety Disorders in School Aged Children

Asthma is the most common chronic childhood disease, characterized by attacks that make a child or adult feel like they are unable to breathe (Shohat, Graif, & Garty, 2005). Almost 6.3 million children between the ages of 5 and 14 are currently affected by asthma (Environmental Protection Agency [EPA], 2006). These same children are likely to experience repeated hospitalizations, emergency rooms visits, and school absences (Shohat et al., 2005). They are likely to be at increased risk for mental and physical disorders that can co-occur with their asthma problems.

One problem for children with asthma is when they also develop anxiety problems. Asthma attacks can provide the same physical feelings as an anxiety attack. Both constrict the air passages and make a person feel like they are unable to breathe. Anxiety and asthma often co-occur. As asthmatic children are predisposed to biological risk factors (Katon, Richardson, Lozano & McCauley, 2004) or exposed to environmental and family risk factors, they will be more likely to have mental health problems. Environmental and family risk factors include coming from a family with a low socioeconomic status, having a parent with unstable mental health, or coming from a single parent home, (Goodwin, Fergusson, & Horwood, 2004). More

specifically, high-risk children with asthma may be more likely to develop anxiety disorders alongside their asthma problems.

Asthma Background

Three possible theories of why children may develop asthma include having a weak immune system, coming from a high-risk family, or enduring many illnesses and infections as a baby or young child. These infections typically concern the lungs and respiratory system. When children have all three of these risk factors they are 50% more likely to develop asthma than children who were only predisposed to the disease. However, this risk declines with age (Mrazek, 2003).

A child is typically diagnosed with asthma after they begin to experience breathing problems. Asthma attacks begin by the creation of extra sticky mucus that congests air tubes. Next, the air tubes will become larger than normal and muscles will constrict. These changes cause the air tubes to narrow making it harder to breathe (Gustafsson, Olofsson, Niclas, Andersson, & Florence, 2002, as cited in Katon et al., 2004).

Asthma is a problem of national concern. The prevalence of this life threatening disease is still increasing. In 2006, it was reported that asthma affects 6.3 million

children and 20 million people total (EPA, 2006). Each year these 20 million people are hospitalized 500,000 times, visit the emergency room 1.2 million times, miss 10 million days of school and 3 million days of work, along with constant difficulties (Hommel, Chaney, Wagner, & McLaughlin, 2002).

A few proven triggers include cats, dogs, cigarette smoke, and dust. If these triggers are in a child's surroundings they will only make asthma worse. Treatments for the improvement of asthma include anti-inflammatory medications, inhaled steroids, removing triggers from the child's environment, and even mental and physical interventions. Overall, asthma is now a major health concern in the United States (EPA).

Internalizing Psychological Problems and Asthma

In the 1930s, asthma symptoms were originally thought to be psychosomatic and those who complained of breathing problems and attacks were not taken seriously (Mrazek, 2003). Asthma patients were also frequently suffering from psychological disorders, therefore leading people to believe asthma was not a biological disease. However, through research, professionals have found that asthma is a biological disease that frequently co-occurs

with psychological problems. "Specifically it appears that youth with asthma are a high risk group for mental disorders and that having a mental disorder appears to be inversely related to successful asthma management" (Hommel et al., 2002, p. 190). Psychological factors such as anxiety problems can predict the quality of life for a patient with asthma (Hommel et al., 2002). Asthma already leads to increased school absence and other social difficulties for children but when anxiety is also a factor the child's quality of life may be at risk.

Anxiety Background

Anxiety is another national problem. Nineteen million American adults suffer from various forms of anxiety disorders. Children can develop anxiety as young as age 6 (Anxiety Disorders Association of America [ADAA], n.d.). Although anxiety comes in all kinds of forms, the most common for children are separation anxiety disorder, specific phobias, social anxiety disorder, and panic disorder. Separation anxiety is the most prevalent and it will often develop suddenly (ADAA). Children who never had any problems going to school or going to a friend's house will suddenly revert to toddler ways because leaving a parent can be extremely stressful.

Anxiety is sometimes triggered by a tragic life event. If children are not treated for their anxiety problems it can cause poor school performance, low social confidence, and they engage in substance abuse problems (ADAA). Anxiety and asthma attacks feel somewhat similar and could be confused with one another.

Anxiety and Asthma

Asthma is more likely to co-occur with anxiety disorders than it is with depression. The prevalence of child patients with asthma suffering from anxiety disorders is found to be as high as 4.7% (Katon, et al., 2004). Most asthmatic children with an anxiety disorder are afflicted with panic disorder or separation anxiety but other forms of anxiety that have proven to be a problem include isolated panic attacks, generalized anxiety disorder, and overanxious disorder. Graham, Rutter, and Pless's, (1967) study (as cited in Vila, Nollet, Clemencon, de Blic, Mouren, Simeoni, and Scheinmann, 2000) found an overall higher incidence of psychological problems for children with severe asthma, which can be extended to include anxiety disorders. These findings have been verified in comparisons between children with and without asthma (Kashani, König, Sheperd, Wilfley, & Morris, 1988, as

cited in Katon et al., 2004) and studies between children with different diseases (Vila et al., 2000).

Vila et al. (2000) looked at 82 children from the ages of 8 to 15. All of the children had moderate to severe asthma. The children with asthma were compared to healthy students. Children were matched on age, sex, and SES. The children were evaluated using the Revised Schedule for Affective Disorders and Schizophrenia for School Aged Children, present episode version (K-SADS-R) along with the Anxiety and Fears Behavioral Scale. It was found that 42% of the participants were afflicted with a DSM-IV diagnosis. Thirty-five percent had some sort of an anxiety disorder, which was more prevalent than any other DSM-IV disorder.

Stauder and Kovacs (2003) found similar results to Vila et al. (2000). Their study originally looked at 646 patients with allergy problems; however they only received a response rate of 60 patients to complete the psychiatric interview. Almost 60% of the patients had rhino-conjunctivitis and 26% had asthma. The rest were considered "other" allergies. The asthma group was found to have the highest prevalence of anxiety disorders with 30.1%.

Although Stauder and Kovacs (2003) originally set out to compare psychiatric problems among patients with various allergy and asthma problems they identified multiple risk factors towards comorbidities as well. These risk factors include "female gender, older age, perennial symptoms…strong emotions, extreme cold or warm and considerable limitation in everyday activities" (Stauder & Kovacs, 2003, p. 821). However, these pertain more to adults. Stauder and Kovacs (2003) did not report on the significance of these multiple risk factors nor did they say if one made more difference than the other or what risk factors are likely to co-occur with one another to produce anxiety and asthma in a patient.

Complex Relationship

The relationship between asthma and anxiety is very complex (Goodwin, Messineo, Bergante, Hoven, & Kairam, 2005). It is unclear if asthma is likely to trigger anxiety attacks or if being more anxious can bring on asthma problems. "First it is possible that asthma…may increase the likelihood of manifesting symptoms of separation anxiety…second it may be that having an anxiety disorder may increase the risk of onset of asthma" (Goodwin et al., 2005, p. 645). Perhaps, people could even

confuse anxiety symptoms for asthma symptoms or the other way around. It could even be possible that patients with anxiety disorders tend to exaggerate the negative aspects of their lives such as stress or physical discomfort. They may embellish on asthma symptoms and somatic symptoms that are worse than they actually are (Goodwin et al., 2005).

Biological Theories

There are biological reasons for why asthma and anxiety symptoms could be confused with one another. Both make the child feel like they are unable to breathe due to airway constrictions and rapid heart beating. Neurons in the brain even provide similar sensations during the two attacks (Katon et al., 2004). Both types of attacks make patients feel scared in similar ways.

The exposure to an abnormal amount of carbon dioxide has also been found to make patients feel like an attack is coming. Children's respiratory rates will increase and they may report more somatic symptoms after the carbon dioxide exposure. Respiratory abnormalities are more prevalent in children with both anxiety and asthma. This can lead to fears that can be triggered biologically by asthma or mentally by anxiety (Katon et al., 2004).

However, a few recent studies have found physical symptoms that can differentiate between asthma and anxiety attacks. These symptoms include wheezing, coughing, and the making of mucous (Katon et al., 2004). These indicators need to be verified through further studies. Still, this may be the first step to determining if asthma triggers anxiety or if it is the other way around.

Environmental Risk Factors

It is important to remember that there are multiple risk factors in various domains for developing both anxiety and asthma. Studies also look at the effects environmental factors have on children's asthma. Goodwin et al. (2004) conducted a longitudinal study looking at the risk factors that young adults with asthma were exposed to and may affect their asthma. Their analyses are based on over 1,000 participants. Measures towards risk factors and comorbidity include the use of the Composite International Diagnostic Interview (CIDI), and the Elley-Irving scale. The participants with asthma were between 2-3 times more likely to have difficulty with anxiety.

A general risk factor termed childhood adversity was measured. It was defined by socio-economic adversity, parental change and conflict, exposure to abuse,

and parental adjustment. "…increasing exposure to childhood adversity was associated with increasing risks of asthma, depression, anxiety disorder and panic attacks (Goodwin et al., 2004, p. 1470-1471)." It could possibly explain why asthma and anxiety often occur together.

One limitation of this study includes defining childhood adversity in many different ways but only looking at it in one way. Instead of looking at parental conflict and exposure to abuse as separate risk factors, Goodwin et al. simply stated that all of these various factors affect asthma. However, they should all be looked at separately in order to determine their individual effects. It is possible that parental conflict may have more of an effect than exposure to abuse. Yet, they are looked at together so it is difficult to determine the exact effects of each one.

Two interesting indicators of an elevated comorbidity of anxiety and asthma are the number of hospitalizations and the amount of health care usage (Katon et al., 2004, Goodwin et al., 2005). These same children wheezed more often and functioned at a lower level. The health care usage was measured using patients at an inner city clinic indicating a socioeconomic status effect. When

children live in neighborhoods with a higher socioeconomic status they have more material and social resources (Juhn, Stauver, Katusic, Delfino, Weaver, & Yunginger, 2005). Children from inner city neighborhoods are more likely to become exposed to dangerous asthma triggers which increase their odds of wheezing (Juhn et al., 2005). Children have more severe asthma and therefore leading to the development of anxiety disorders. A highly severe case of asthma coupled with many risk factors makes a child much more vulnerable to developing anxiety problems that can only make the child's asthma worse.

Family Risk Factors

Some studies have looked at individual family risk factors. Parent mental health has been found to affect asthma (Calam et al., 2003). While looking at young children and their families with asthma, Calam et al. (2003) found parental instability could exacerbate behavior problems and asthma severity. Parental instability was defined as mental health problems such as maternal depression. The behavior problems found in children could probably also extend to anxiety problems. If parents are afraid of upsetting their child while trying to take care of their asthma, they may in fact make the asthma and the

anxiety worse. Parents with poor mental health may be less available to take care of their children. This can include taking children to scheduled doctor's visit or even giving them the daily medications that they need.

Katon et al. (2004) has also shown that children of parents with panic disorder are more likely to display respiratory abnormalities. Respiratory problems can lead to and complicate asthma and anxiety attacks. Maternal depression has also been identified as a possible risk factor (Goodwin et al., 2005).

Sometimes the whole family can have an effect on the child's asthma and anxiety levels, not just the mother. In Markson and Fiese (2000), they examine the importance of family rituals as a preventative factor for children with asthma developing anxiety. Family rituals can often represent the amount of chaos or stress that a family is currently enduring. The organization of a family can prove to be extremely important in risky families and even decrease the prevalence of asthma. "Stressful life events, the family environment, and variation in acute and chronic health conditions can all affect outcomes of a pediatric condition" (Markson & Fiese, 2000, p. 472).

Markson and Fiese looked at 43 families of children with asthma and 43 families of children without asthma. The children with asthma ranged from mild to severe. The family stress score was based on asthma levels, emergency room visits, missed school days, self report from family members, and the number of stressful events. It was found that organized family rituals and less chaotic households might prevent children from developing anxiety.

Negative Effects of Asthma and Anxiety

No matter what causes asthma or anxiety, both of the disorders can lead to negative effects. Children afflicted with asthma and anxiety will have a lower functional status, decreased self-esteem, less effective asthma management, and impaired development (Katon et al., 2004). Vila et al. (2000) found that just patients with asthma do not have low self-esteem but those with the added anxiety disorder did along with low social competence. Overall, there are a host of risk factors that can lead to the comorbidity of asthma and anxiety. Attacks from both asthma and anxiety indicate negative consequences in a child's life.

Multiple Risk Factor Approach

It is clear that the comorbidity of asthma and anxiety must be attributed to more than one risk factor. Goodwin et al. 2004, Vila et al. 2000, and Stauder et al. 2003 all consider multiple risks as contributing to children having both asthma and anxiety. It is important to remember that very often one risk factor may not be significant to indicate causation and it may be necessary to combine and analyze the risks in many different ways.

Juhn et al. (2004) looked at the influence of neighborhood and SES risk factors on asthma prevalence. The study organized many of the different risk factors into different groups and combinations when assessing the results. This can show which risk factors may cause problems when they occur together or which may be more likely to contribute to asthma and anxiety. Overall, the multiple risk approach can provide better results for assessing the comorbidity of asthma and anxiety.

Family Life and Asthma Project

Currently, there is an ongoing study at Syracuse University called The Family Life and Asthma Project. A large team of researchers is looking at family and asthma factors that affect daily routines and rituals for families of

children with asthma. The participants are ages 5-12 from all different economic backgrounds. Parents are also important participants. They fill out questionnaires about their family concerning family rituals, parent mental health, perceived asthma severity of their child, and daily and overall life stress. The child fills out many of these forms along with an IQ test and they engage in storytelling about family rituals particularly dinnertime. Every three months longitudinal families must participate in phone diaries asking about dinnertime, medication routines, and the overall stress level of the family. Longitudinal families also participate in medication tracking to see how well the children adhere to their prescribed medications.

This study will use the data collected by The Family Life and Asthma Project to look at the comorbidity of anxiety and asthma in school aged children. All participants in this particular study have asthma and have completed the MASC therefore making them between the ages of 8 and 12.

Hypothesis and Purpose

It is hypothesized that when children in the Family Life and Asthma Project will have high anxiety levels it will be due to significant relationships with four risk factors from the biological, environmental and familial domains. Child anxiety will also significantly relate to a combination of the four risk factors. The four factors are asthma severity, socioeconomic status, mental health status of the primary caregiver, and the level of family stress. Most studies tend to separate biological, environmental, familial risk factors but this study will be combining the risk factors, as well as looking at each separately to determine significant relationships and effects.

The biological risk factors will be determined through the Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin, & Phelan, 1994). Socioeconomic status will be determined by the Index of Social Status Hollingshead (Hollingshead, 1975). Parent mental health will be taken from the parents' self report on the Brief Symptom Inventory (BSI) to see if they show signs of significant depression or anxiety disorders (Derogatis, 1993). Family stress levels will be assessed using the Family Inventory of Life Events (FILE), which looks at significant life events in the past year (McCubbin,

& Patterson, 1981). Child anxiety levels will be assessed

using the MASC (March, 1997). Overall, the Family Life

and Asthma Project is a comprehensive set of data derived

from a research study set in Syracuse, New York. It will

provide reliable results for the various possible correlations

and relationships.

Method

Participants

Participants were drawn from the families that are

involved with the Family Life and Asthma Project.

Seventy-two families were chosen based on which children

were old enough to complete the MASC in order to

measure anxiety. All families live in or within 60 miles of

Syracuse, New York. Refer to table 1 for complete

demographic information. Differences in 'n' of child age

and primary caregiver age are due to primary caregivers not

reporting their age.

Measures

There were five main measures used in this study.

They include the Functional Severity Scale for Children

with Asthma, the Index of Social Status Hollingshead,

Brief Symptom Inventory, Family Inventory of Life

Events, and the Multidimensional Anxiety Scale for

Children. Refer to table 2 for descriptive statistics about the measures.

Functional Severity Scale (FSS) (Rosier et al., 1994)

The Functional Severity Scale is a six item inventory that was used to determine asthma severity and in turn biological risk factors. It uses Likert scale type questions to assess the severity of asthma issues like the frequency of coughing, wheezing and asthma attacks. It also asks about how often asthma may limit the child's daily life and activities. The primary caregiver completes it during their lab visit. During scoring, children are assigned into four bands, low, mild, moderate, and severe.

The FSS is a reliable and valid measure. It significantly correlated with school absence from wheezing (r=0.30), functional impairment, (r=0.30) and amount of medication (r=0.36). The item reliability was 0.89 and the person reliability was 0.54.

Index of Social Status Hollingshead (Hollingshead, 1975)

The Hollingshead Index looks at socioeconomic status through parent self report. It analyzes socioeconomic status with multiple dimensions. Parents report four factors including occupation, education level, sex, and marital status. It asks multiple questions about

parents and their spouses. Scores range from 8-66

depending on a combination of the factors. Occupation

carries the most weight and is assessed on a 0-9 scale while

education is assessed on a 1-7 scale. The Hollingshead

Index is validated through US Census data and various

research groups. It correlates with the NORC prestige

score measure with r=.927.

Brief Symptom Inventory (BSI) (Derogatis, 1993).

The BSI has proven to be a reliable test for looking

at various aspects of parent mental health. In this case the

parent is going to be the primary caregiver, which is almost

always the mother. The BSI has 53 items completed by

self report and answers are rated through a five point scale

0 being "not at all" to 4 being "extremely." The BSI is

typically used to assess nine different domains of

psychological symptoms in almost anyone, from a person

in the community, to psychiatric patients, to medical

patients.

The nine domains represented by the questions on

the BSI are somatization, obsessive-compulsive,

interpersonal sensitivity, depression, anxiety, hostility,

phobic anxiety, paranoid ideation, and psychoticism.

However, this study focused on the depression and anxiety

subscales to represent parent mental health. Sample

questions for depression include "thoughts of ending your

life, feeling lonely, or feeling blue." Questions for anxiety

include fearing fearful, spells of terror or panic, or feeling

afraid in open spaces.

The BSI has proven reliability and validity. It

measures reliability by internal consistency and the test-

retest methods. With respect to internal consistency, the

BSI had strong alpha coefficients ranging from .71 to .85.

The validity of the BSI is found to be highly convergent

with the MMPI scales.

Family Inventory of Life Events (FILE) (McCubbin &

Patterson, 1981).

The FILE is given to the parental participants

during their lab visit. It looks at significant life events that

occur in the last year. It has 66 questions that are all

answered with either a 'yes' or a 'no.' Some examples of

questions include "a member appears to have emotional

problems, spouse was separated or divorced, decrease in

satisfaction with job/career, or child became seriously ill or

injured." The FILE has been tested for both reliability and

validity. It received a .72 measured by Cronbach's Alpha

Reliability. Its correlations also were compared with the

Family Environment Scale. Total Recent Life Changes correlated negatively with the FES dimensions of cohesion (r=-.24), independence (r=-.16) and organization (r=-.14) and positively with conflict (r=.23), this correlation supporting construct validity. The more stressful life events the parents endured the more likely stress is to probably affect the child's well being along with the parent child relationship.

Multidimensional Anxiety Scale for Children (MASC) (March, 1997)

The MASC was used to determine anxiety levels in the school children selected for this study from the Family Life and Asthma Project. It is administered during the child's lab visit and completed by the child. It is a Likert-scale type questionnaire with thirty-nine items assessing anxiety through questions like "I have trouble getting my breath, I'm jumpy, I worry about getting called on in class, my heart races or skips beats, and I feel shy." It scores across four major factors including physical symptoms, social anxiety, harm avoidance, and separation anxiety. There are five subscales that make up the four factor totals. The tense/restlessness and somatic/autonomic subscales pertain to the physical total. The social anxiety total is

comprised of the humiliation/rejection and the public

performance fears subscales. The harm avoidance total is

made up of perfectionism and the anxious/coping

subscales. Internal reliability coefficients ranged form .6 to

.9. Individual items correlated with each other between

r=.4 and r=.8

Procedures

The Family Life and Asthma project is an ongoing

project in Syracuse, New York. Participants are recruited

from 4 pediatric clinics in and around Syracuse. In order to

be recruited the participants must have been diagnosed with

asthma for at least a year and been on daily prescribed

medications for at least six months. Families were phoned

soon after showing interest to make an appointment to visit

the lab in Syracuse. Parent participants signed written

informed consent documents and assent was obtained from

children. Cross sectional participants visit the lab one time;

have one home visit and a med tracking period. They

receive a compensation of $200 spread over 6 weeks.

While at the lab, parents and children are separated to fill

out a variety of questionnaires and story telling and self

report procedures. Childcare is provided for siblings.

Parents begin by filling out a primary caregiver packet, which contains the data for the demographics. The BSI, Hollingshead, and the FSS are also administered to the parent at the lab. The FILE is administered in the home packet during the home visit.

Children complete the MASC during their lab visit. Table 3 summarizes the mean, standard deviation, and range of scores obtained from the measures used in this study.

Results

Data were analyzed using JMP 5 (2002). Twenty-five percent of the 72 children who completed the MASC scored in the clinical range for anxiety problems. This is receiving a total score of 65 or above. Fifty-six percent of the sample had moderate-severe asthma as determined by the FSS.

For the correlations, I examined the relation between children's anxiety and the identified risk variables. Simple bivariate correlations were generated. No significant correlations were found between the MASC and BSI. There were a few correlations between the MASC subscales and the Hollingshead, FSS, and FILE. See tables 3 and 4.

For some of the variables it makes more sense to consider them as categorical rather than continuous. In these cases, analysis of variance was conducted to compare group differences on MASC scores. The different groups examined were marital status (single parent vs. dual parent), the depression and anxiety BSI subscales, the FILE and the Severity Scale for the FSS. The Hollingshead was not used because of the multiple correlations found and turning it into a categorical variable may be difficult.

The MASC was used as a continuous variable for all of the ANOVA comparisons. Based on published norms, the BSI scores were divided into two groups (Derogatis, 1993). The first group did not have clinical scores for anxiety (x<60). The second group was considered either clinically depressed or anxious (x>60). The FILE scores were divided into two groups as well. One group was considered high risk (x>16) and the other was considered low risk (x<16) (McCubbin, & Patterson, 1981). The Severity Scale for the FSS gives a score of 1, 2, 3, or 4 depending on the level of asthma. Children receiving a score of 1 or 2 were put into the mild asthma group and scores of 3 or 4 were put into the severe asthma group (Rosier et al., 1994). Marital status was divided

between single and dual parent households. Children were considered to be living in a single parent household due to divorce, death, or having a single parent. Households were categorized as dual parent when parents were married, remarried, or cohabiting. Refer to table 5 for a complete list of ANOVAs.

MASC and the BSI

No significant correlations or ANOVAs were found between the BSI anxiety or depression scales and any part of the MASC.

MASC and the FILE

One correlation was found between somatic symptoms subscale of the MASC and the total FILE score ($r=0.21$, $p<.09$). However, this correlation did not reach standard levels of statistical significance.

MASC and the Hollingshead

Although the MASC total score did not correlate with the Hollingshead there were other significant relationships. The somatic and autonomic subscale of the MASC correlated with the Hollingshead ($r=-0.22$, $p<.05$) and the physical symptoms subscale of the MASC correlated with the Hollingshead ($r=-0.24$, $p<.04$) as well. Negative correlations are due to the fact that lower scores

on the Hollingshead indicate a lower socioeconomic status while higher scores on the MASC mean higher levels of anxiety.

MASC and the Functional Severity Scale

Two correlations were statistically significant between the MASC and the FSS. The MASC performance fears subscale and the FSS were significant at ($r=0.34$, $p<.004$) and the MASC social total subscale and the FSS were significant at ($r=0.24$, $p<.04$). Two significant ANOVAs were found between the MASC and the Severity Scale for the FSS for the same subscales. The first significant ANOVA was between the Severity Scale for the FSS and the performance fears subscale ($F_{(1, 68)}=3.66$, $p<.02$). The second significant ANOVA was between the Severity Scale for the FSS and the social total subscale ($F_{(1, 68)}=2.69$, $p<.05$).

MASC and Marital Status

Surprisingly, the MASC also had significant findings when tested with the marital status. Single versus dual parent homes seem to have an effect on the somatic subscale of the MASC (($F_{(1, 71)}=3.39$, $p<.07$) and the physical total subscale on the MASC ($F_{(1, 71)}=2.83$, $p<.09$). However, these comparisons do not reach standard levels of statistical significance.

Multiple Risk Factor Effect

Within the sample of 72 child participants, 20 children had 0 risk factors, 24 had 1 risk factor, 12 had 2 risk factors, 4 had 3 risk factors, 2 had 4 risk factors, and 1 had 5 risk factors. The five risk factors include parental depression, parental anxiety, low socioeconomic status, asthma severity levels, and families with a lot of stress. Risk was defined as the presence of parental depression (score of $x>60$ on the BSI), parental anxiety (score of $x>60$ on the BSI), high levels of family stress (score of $x>16$ on the FILE), severe asthma (score of $x>2$ on the severity scale for the FSS), and parent education level as an indicator of socioeconomic status (less than a self reported level of high school education). Mean levels of anxiety increased for children with zero, one or two risk factors. However, at 3, 4 and 5 risk factors, the anxiety levels inconsistently increased and decreased. Refer to table 6 for ANOVAs between the MASC total and subscales and risk score. Refer to charts 7-11 for mean values of anxiety.

Discussion

The purpose of this study was to determine which risk factors or combination of risks contribute to the comorbidity of asthma and anxiety in a pediatric

population. The risk factors included family stress, asthma severity levels, parent mental health status and SES. The results of this study can partially support the main hypothesis. It seems that biological risk factors play a role in anxiety levels along with family stress and SES while parent mental health was insignificant. The combination risk score showed trends with anxiety levels but was not statistically significant. It is imperative that research continues to look for the causes of comorbidity of anxiety and asthma.

This study found an unusually high percentage of anxiety (25%) according to the MASC. It was much higher than the 4.7% prevalence found by Katon et al (2004) but slightly lower than Vila et al's (2000) finding of 35%. It was on relatively on target with Stauder and Kovac's (2003) 30.1% prevalence rate.

This high prevalence rate may be due to factors from nature. However, more likely it is due to who gets recruited to the main project. A lot of participants come from a major clinic in Syracuse, New York where the doctor is known for hypnosis. This particular doctor specializes in finding ways to calm patients and families that have trouble dealing with asthma. He uses hypnotic

methods that attract a high number of anxious patients. By sampling heavily from this clinic, it is easy to understand the possibility of finding an elevated rate of anxiety in these participants.

Relationships with Biological Risk Factors

What really contributes to this high comorbidity? Studies have hypothesized anything from biological risk factors to environmental and family issues. This study found a significant relationship between anxiety levels and biological risk factors. Biological risk factors were determined using the Functional Severity Scale and indicated that when children have more severe asthma they will become more anxious. They particularly become more anxious in the areas of performance fears and social fears. These results support Katon et al.'s (2004) findings on anxiety levels being influenced by severe asthma.

Asthma may relate more to performance and social fears because having an asthma attack can actually be embarrassing for children. While others are running around in a soccer game, a child with asthma may have to take medicine or may even need to stop the game to get help from an adult. For young children, who worry about fitting in, this could cause them to be shy or scared to

perform in front of a group of peers. This could even extend to situations beyond physical activities such as classroom performance.

It is not surprising that severe asthma relates to higher anxiety levels due to the similarity of their physical symptoms. Patients often confuse the symptoms of breathing difficulties from an anxiety attack to actually be a real asthma attack (Goodwin et al., 2005). Overall, it seems like a main risk for the comorbidity of asthma and anxiety is the actual asthma.

Effects of SES and Environmental Risk Factors

Environmental risk factors were found to play a role as well in the levels of anxiety among the participants. The Hollingshead Index correlated with both the somatic symptoms subscale and the physical total subscales of the MASC. The symptoms subscale is one component of the physical total subscale. Feeling extra tense or restless is the other. This gives some indication that children may feel like they are experiencing more severe asthma symptoms than they actually are. These symptoms may be from anxiety attacks rather than their actual asthma.

Socioeconomic status relates to this embellishment of symptoms due to its proven detrimental effects. It

negatively, rather than positively, correlates with anxiety levels because a low score on the Hollingshead indicates a lower socioeconomic status. SES is related to having trouble with abusive parents, neighborhood violence, and lack of parental involvement due to money and occupation problems. These factors are all components of Goodwin et al's (2004) childhood adversity general risk factor. Goodwin et al. (2004) found a positive correlation between anxiety levels and childhood adversity that can be equated with the negative correlation between the Hollingshead and the MASC.

SES can contribute to anxiety among children with asthma in many ways. First, it may mean that the parent spends less time with the child therefore medication usage could decrease. Many of the medications have a co-pay as high as $15 every single month and this may be difficult for some families to afford.

SES may make children more anxious about their actual asthma because those from a low SES spend increased time in hospitals (Katon et al., 2004, Goodwin et al., 2005). When children spend more time in hospitals they may worry about the slightest cough or a little sneeze because they know it sometimes indicates a bigger

problem. Children want to be running around, not spending their time at the doctor where children of lower SES are more likely to visit.

Children living in a lower SES area may also be exposed to more triggers and toxins in their neighborhood (Juhn et al., 2005). This may cause their asthma severity to rise and due to the fact that asthma severity correlates with anxiety levels, SES is a significant risk factor as well.

Effects of Family Stress and Dynamics

Increased anxiety levels were also related to an increase in family stress. The total score of the FILE positively correlated with the somatic scores on the MASC. This is basically saying that children feel more anxious about their asthma symptoms when there is elevated stress in the family. This agrees with Markson and Fiese's (2000) study that determined that family rituals correlated with less family stress. More organized family rituals tend to decrease stress levels. When families are less stressed, child anxiety levels decrease and there is less of a chance for the development of asthma.

Stress may cause children to keep their problems inside, making them more anxious. Perhaps, children see that their parents are dealing with difficulties and are

nervous about bothering them with asthma problems. Also, when chaos rises, a families' first priority may not be a child's illness, but rather the cause of the stress like a death or losing a job. Stressful events add to a child's list of worries, which can only increase their anxiety about life in general.

Family stress can often relate to the marital status of the child's parents. It was found that children with asthma living in single parent families had higher levels of anxiety than those living in two parent families. Single parent families could result from divorce, death, or never marrying. Dual parent families could result from a lasting marriage, remarriage, or even cohabitation. Although this was not part of the hypothesis or purpose of the study it makes sense. Family stress can often become extremely high when there is a divorce. Therefore, two parent families would be much easier for the child to cope with whether the two adults are biological parents or not.

Unlike family stress and marital status, parental mental health did not have a significant effect on anxiety levels. The results of the current study directly disagreed with Calam et al. (2003) who found that maternal mental health affected children. This particular study did not find

a relationship between child anxiety and maternal mental health. One potential reason for the lack of correlations between the MASC and the BSI, could be due to who was given the measurements. The MASC is completed through self-report by the child whereas the BSI is completed by the primary caregiver. The primary caregiver is almost always the mother (93% in this study). There is always the possibility of report bias.

Perhaps, the child is really overwhelmed and stressed out and the parent is detached due to their anxiety or depression, making them unaware of the situation. Another possibility could be that the parent does not want the researcher to know about troublesome events in their lives so they do not answer completely truthfully. Also, some parents may not want to admit to stress and personal difficulties therefore they may not be honest when answering questions on the BSI. There would probably be more correlations between the measures answered just by the parents rather than measures answered by parents and children.

Multiple Risk Factor Effects

Although each risk factor had an individual relationship with the MASC anxiety levels, the multiple

risk score had an effect as well. The effect however was very interesting. When the risk score was measured with an ANOVA against the MASC total, children ranging between 0-2 risk scores had increasing average levels of anxiety. However, after a score of two on the risk score, the average levels of anxiety began to decline. This could possible be due to outliers because only 7 out of 72 child participants had 3-5 risks in their lives. If there were more children with higher risk scores, the study may have found the average anxiety levels significantly increased with the number of risk factors.

When the risk score was compared with other subscales of the MASC the increase from 0-2 stayed relatively consistent. When the risk factor was equal to three the anxiety score rose for the humiliation/rejection, performance fears, and the social total subscales. When the risk factor was equal to four, the anxiety score rose from the risk score of three with just the MASC total. When the risk score equals five, the MASC the average anxiety score was high for the perfectionism, anxious coping, harm avoidance total, performance fears, and separation anxiety subscales.

This multiple risk finding agrees with Goodwin et al.'s findings from their analyses of the childhood adversity score. This combined multiple aspects of the child's environment and family to show correlations because one risk factor was not enough. The results of this study also coincide with Juhn et al. (2005) findings that many risks in a child's neighborhood and concerning their socioeconomic status factors contribute to anxiety levels in children with asthma. This is one of the few studies however to combine biological, environmental, and familial risks.

Internal and External Validity Strengths

This study has arguably strong internal validity because the measures it used to obtain results are all very reliable. External validity was strong for sample size. It was representative for a diverse group of families from different socioeconomic statuses and both rural and urban areas. It also gave a view of the effect of the asthma on the entire family by using questionnaires completed by both the child and the primary caregiver. Furthermore, it covers many different types of risk factors.

Limitations and Future Directions

However, there were a few limitations that may have affected the results of this study. The chance of self-

report bias, mentioned above, could play a key factor. All of the measures were from either primary caregiver or child self report. However, using both the parent and the child was a strength because it provided two perspectives on one situation. Parents sometimes like to make things seem better or worse than they really are. Sometimes people do not answer honestly. Children can sometimes misunderstand questions and accidentally not answer correctly. However, it is almost impossible to measure how strong of an effect it could really have.

There are a few limitations concerning the sample size. First of all, it could have been larger. Aspects of the sample were not very diverse. Ninety-three percent of primary caregivers were mothers. It would be interesting to do this study with the father as the caregiver.

Also, all of the children used in this particular study had asthma. Perhaps, more significant results would occur by comparing anxiety levels in children with and without asthma. The study can only be generalized to children between the ages of 8-12. This does not include young children, adolescents, or adults. The sample size may also have included a few unnecessary outliers that caused the

occasional drop in anxiety level depending on the number of risk factors the participant had in his or her life.

One final limitation was using only one measure to test each variable. Although each measure has proven to be reliable and valid, it is still beneficial to test for anxiety or family stress levels in a variety of ways.

Due to the high usage of self-report measures it would be interesting to measure these same variables using coding from researchers. Although this can result in researcher bias, if a study was done combining self-report and researcher report, the biases might be reduced or eliminated. This involves using a wide variety of measures to test each variable. It would also be interesting to do this same experiment on all different age cohorts and compare the strength of each risk factor. Other risk factors could be used in future studies like school performance, medication adherence, and exposure to neighborhood violence.

Conclusions

The overall purpose of this study was to show the effect of biological risk factors, family stress levels, SES, and parent mental health on the prevalent comorbidity of

anxiety and asthma in a pediatric population. Due to the national concern of both of these disorders, it is imperative that we find out the causes of this comorbidity. Although this study showed significant relationships between some risk factors and anxiety levels, more risk factors need to be studied and their effects assessed and analyzed.

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Table 1

Demographic Characteristics of Sample

	n	mean	SD	range	% of total
Age					

Child	72	9.54	1.38	12-Aug	___
Primary Caregiver	70	37.36	6.18	25-60	___
Gender					
Boys	47	___	___	___	65.28
Girls	25	___	___	___	34.72
Mother	67	___	___	___	93.06
Father	1	___	___	___	1.39
Other	4	___	___	___	5.55
Child Race	72				
Caucasian	40	___	___	___	55.55
African American	21	___	___	___	29.17
Hispanic	3	___	___	___	4.17
Other	8	___	___	___	11.11
Marital Status	72				
Married	36	___	___	___	49.31
Separated	4	___	___	___	5.47
Divorced	8	___	___	___	11
Remarried After Div.	9	___	___	___	12.32
Single	12	___	___	___	16.42
Cohabiting	4	___	___	___	5.47

Table 2

Descriptive Statistics of Primary Measures

Measure   mean   SD   range

MASC	55.03	11.12	33-84
BSI Depression	51.28	8.68	42-70
BSI Anxiety	50.92	9.81	38-73
FILE	8.95	6.34	0-31
Hollingshead	38.84	18.31	11-66
FSS	9.92	5.81	0-26

Table 3

Correlations between MASC Subscales and the BSI, Hollingshead and the FSS

	BSI-ANX	BSI-DEPR	Hollingshead	FSS

MASC T_R	-0.07	-0.04	0.18	0.09
MASC S_A	0.02	0.002	-0.22*	0.17
MASCPHYSTOTAL	0.04	-0.01	-0.24*	0.14
MASCPER	0.006	-0.2	0.1	0.001
MASCAC	0.09	-0.09	-0.006	-0.04
MASCCHARMTOTAL	0.02	-0.16	0.07	-0.05
MASCHR	-0.04	0.004	0.1	0.11
MASCPP	0.09	0.12	-0.12	0.34**
MASCSOCTOTAL	0.02	0.06	0.02	0.24*
MASCSEP	-0.14	-0.09	-0.16	0.03
MASCTOTAL	-0.02	-0.04	0.11	0.14

Note. MASC T_R=tense and restlessness, MASC S_A=somatic and

autonomic symptoms, MASCPHYSTOTAL=physical symptom total,

MASCPER=perfectionism, MASCAC= anxious/coping,

MASCCHARMTOTAL=harm avoidance total,

MASCHR=humiliation/rejection, MASCPP=performance fears,

MASCSOCTOTAL=social anxiety total, MASCSEP=separation panic,

MASCTOTAL= overall total.

*p<.05, **p<.01

Table 4

Correlations between MASC Subscales and FILE Subscales and Totals

	T.F.	I.F.	M.S.	Preg.	F.B.	W.F.	I. F.C.	Loss.	Trans.

MASC T_R	0.05	-0.08	-0.13	0.11	-0.007	-0.07	-0.03	-0.16	-0.02
MASC S_A	0.21	-0.09	-0.11	0.11	-0.007	0.002	-0.009	-0.05	0.06
MASCPHYSTOTAL	0.15	-0.09	-0.14	0.12	-0.02	-0.03	-0.04	-0.13	0.03
MASCPER	0.02	-0.03	0.02	0.11	-0.01	0.03	-0.05	-0.24*	-0.11
MASCAC	-0.11	0.07	0.15	-0.02	0.13	0.02	-0.01	-0.14	0.002
MASCCHARMTOTAL	-0.04	0.06	0.12	0.05	0.09	0.04	0.0001	-0.16	-0.02
MASCHR	-0.12	0.07	0.06	0.14	0.03	0.09	-0.05	-0.06	-0.04
MASCPP	0.03	0.02	0.02	0.15	-0.008	0.16	0.12	-0.03	-0.08
MASCSOCTOTAL	-0.07	0.06	0.03	0.17	0.008	0.13	0.02	-0.06	-0.07
MASCSEP	-0.11	-0.06	0.04	0.14	-0.06	0.05	-0.14	-0.08	-0.05
MASCTOTAL	-0.01	-0.02	-0.02	0.16	0.01	0.05	-0.05	-0.14	-0.04

Note. T.F=total file, I.F.=intrafamily strains, M.S.=marital status stress, Preg.=pregnancy strains, F.B=family and business strains, W.F=work and family strains, I.F.C.=illness and family care strains, Loss.=losses, Trans.= transitions in and out. MASC T_R=tense and restlessness, MASC S_A=somatic and autonomic symptoms, MASCPHYSTOTAL=physical symptom total, MASCPER=perfectionism, MASCAC= anxious/coping, MASCCHARMTOTAL=harm avoidance total, MASCHR=humiliation/rejection, MASCPP=performance fears, MASCSOCTOTAL=social anxiety total, MASCSEP=separation panic, MASCTOTAL= overall total.

*p<.05

Table 5

ANOVAs between MASC Subscales and Total and BSI, FILE, FSS and Marital Status

	BSI-ANX	BSI-DEPR	FILE	FSS	Marital Status

MASC T_R	0.14	0.006	2.47	1.07	1.31
MASC S_A	1.4	0.62	1.71	1.53	3.39
MASCPHYSTOTAL	0.75	0.23	2.45	1.42	2.83
MASCPER	2.46	2.4	0.15	0.23	0.0003
MASCAC	0.03	0.64	0.33	0.43	0.05
MASCCHARMTOTAL	0.66	1.51	0.034	0.7	0.17
MASCHR	0.001	1.08	0.03	1.18	0.43
MASCPP	0.24	0.2	0.12	3.66*	0.7
MASCSOCTOTAL	0.66	0.8	0.08	2.69*	0.003
MASCSEP	0.007	0.75	0.14	0.69	0.69
MASCTOTAL	0.23	1.21	0.09	1.12	0.72

Note. MASC T_R=tense and restlessness, MASC S_A=somatic and

autonomic symptoms, MASCPHYSTOTAL=physical symptom total,

MASCPER=perfectionism, MASCAC= anxious/coping,

MASCCHARMTOTAL=harm avoidance total,

MASCHR=humiliation/rejection, MASCPP=performance fears,

MASCSOCTOTAL=social anxiety total, MASCSEP=separation panic,

MASCTOTAL= overall total.

*p<.05, **p<.01

Table 6

Mean Values of Anxiety Levels for MASC Subscales and Total and Risk Score

# of Risk Factors

	Zero	One	Two	Three	Four	Five	F-Ratio
MASC T_R	51.25	51.71	56.42	49.25	50.5	40	0.81
MASC S_A	49.4	54.5	54.42	51	46	39	1.19
MASCPHYSTOTAL	50.5	53.67	56.42	50.5	48	38	1.06
MASCPER	50.35	52.79	51.58	51.5	26.5	54	2.51
MASCAC	56.6	53.13	59.42	57	40	67	1.7
MASCCHARMTOTAL	54.7	52.04	56.75	55.5	33.5	64	1.6
MASCHR	50.1	53.42	53.17	54.5	40	46	0.74
MASCPP	46.1	54.63	52.08	53	49.5	55	1.62
MASCSOCTOTAL	48.15	54.58	52.92	54.25	44	50	1.03
MASCSEP	57.2	58.58	51.57	59	47.5	62	0.64
MASCTOTAL	52.4	56.75	59	56	40.5	52	1.35

Note. MASC T_R=tense and restlessness, MASC S_A=somatic and autonomic symptoms, MASCPHYSTOTAL=physical symptom total, MASCPER=perfectionism, MASCAC=anxious/coping, MASCCHARMTOTAL=harm avoidance total, MASCHR=humiliation/rejection, MASCPP=performance fears, MASCSOCTOTAL=social anxiety total, MASCSEP=separation panic, MASCTOTAL= overall total.
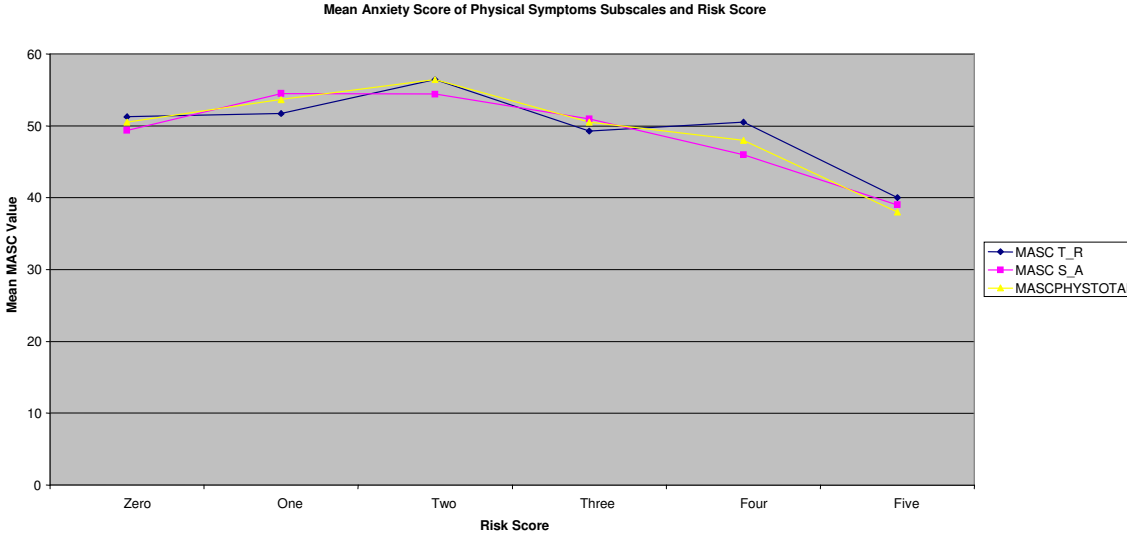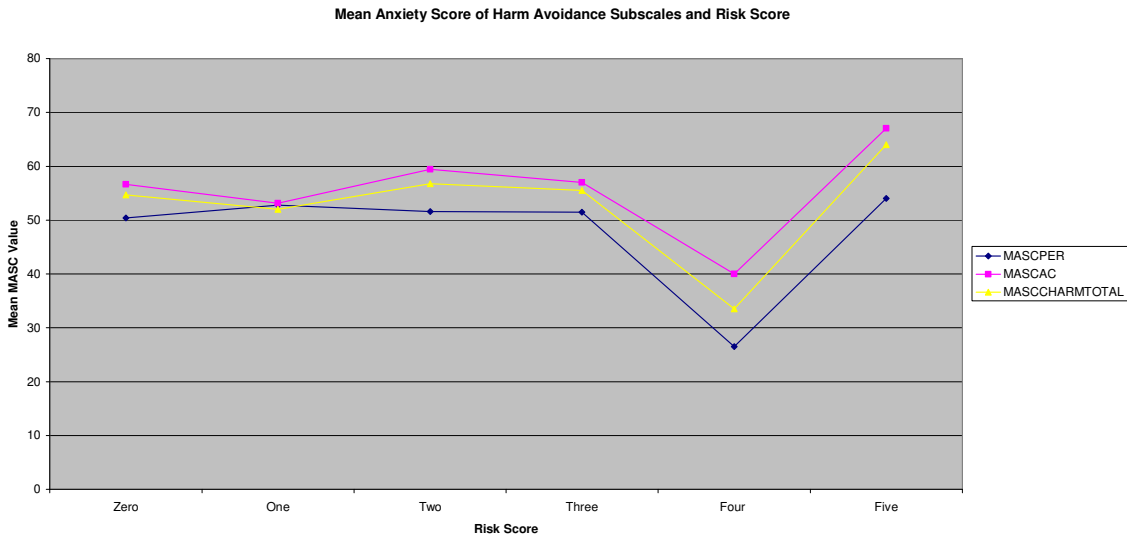
Chart 7

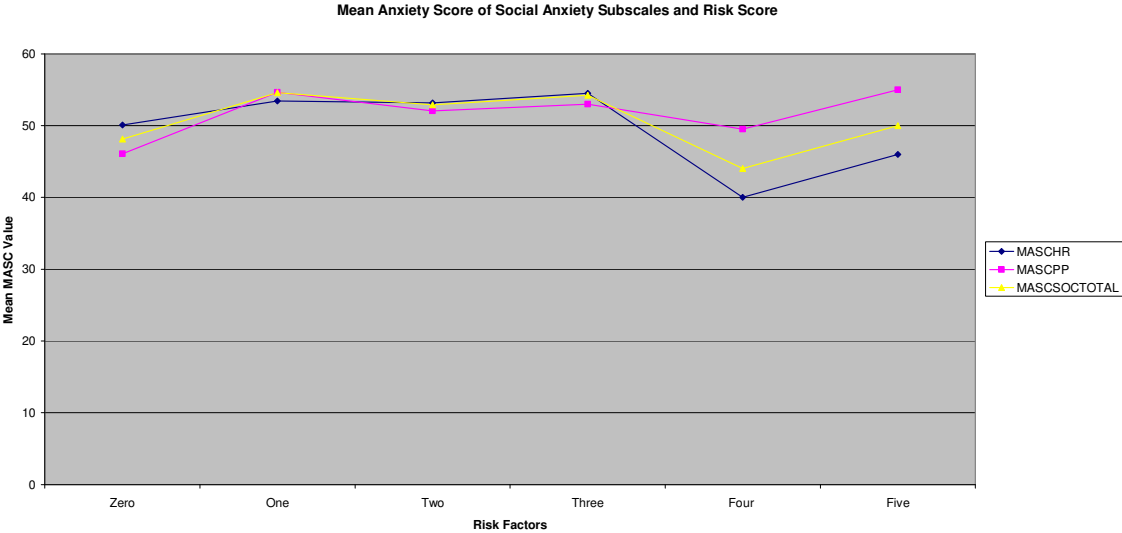**Mean Anxiety Score of Physical Symptoms Subscales and Risk Score**

Chart 8

Mean Anxiety Score of Harm Avoidance Subscales and Risk Score

Chart 9

Mean Anxiety Score of Social Anxiety Subscales and Risk Score

Chart 10

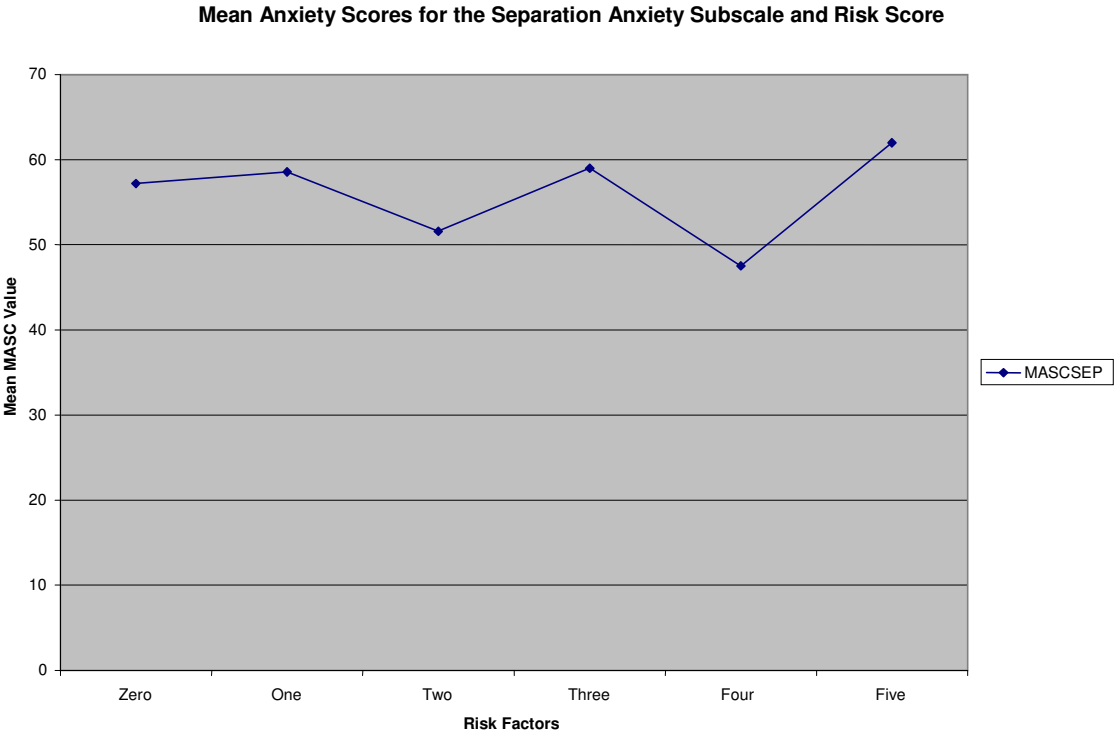**Mean Anxiety Scores for the Separation Anxiety Subscale and Risk Score**

Chart 11

Mean Anxiety Scores for the MASC Total and Risk Score