Journal of Clinical Psychology in Medical Settings (© 2006)
DOI: 10.1007/s10880-006-9026-7

Allergies and Anxiety in Children and Adolescents: A Review of the Literature

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There is an increasing prevalence of anxiety disorders and allergic conditions in children and adolescents, with previous research showing that these illnesses are often comorbid. Knowledge of the association between anxiety and allergies in children and adolescents is important because these comorbid disorders may negatively impact functioning and development. This research is necessary for identification of at risk children and to develop intervention and prevention programs. A review of studies examining comorbid anxiety and allergies in children and adolescents demonstrated a consistent association between these disorders despite differences in methodology. Several methodological limitations are presented, followed by a discussion of theories which may explain the association between these conditions. Implications of this work and suggestions for future research are provided.

KEY WORDS: allergies; anxiety; children; adolescents; comorbid.

Allergic conditions have been identified as one of the most common medical conditions currently affecting children and adolescents (Stone, 2003). Estimates of the prevalence of childhood allergic conditions in the United States indicate that approximately 35% of children under the age of 18 are diagnosed with an allergy (National Center for Health Statistics [NCHS], 2002). Recent research has shown that prevalence rates of childhood allergic conditions have increased worldwide over the past decade for unknown reasons (Moss & Lemanske, 1999). Childhood allergies are considered chronic illnesses because they persist for more than three months and cannot be cured (NCHS, 2002; Newacheck & Taylor, 1987). Childhood allergies include allergic rhinitis, asthma, dermatitis, and allergic reactions to food and chemical substances.

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Allergic Conditions in Children and Adolescents

Allergic Rhinitis

Allergic rhinitis is one of the most common chronic illnesses affecting children, with prevalence estimates ranging from 20 to 47% (see Schoenwetter, 2000, for a review). The prevalence of allergic rhinitis has increased worldwide within the past several years (Schoenwetter, 2000; Stone, 2003). This condition is more common in boys than girls and the mean age of onset is between 6 and 10 years (Wright et al., 1994). The term hay fever is often used interchangeably with allergic rhinitis and refers to allergic rhinitis that occurs during specific seasons (e.g., spring, Bellanti & Wallerstedt, 2000).

Asthma

Asthma affects approximately 5 to 12% of children under the age of 18 (NCHS, 2002; Akinbami, Schoendorf, & Parker, 2003). The prevalence of asthma has increased approximately 4% per year since 1980 (Akinbami & Schoendorf, 2002). This condition is more common in boys than girls and affects

more African American and Latino children than Caucasian children (NCHS, 2002). Approximately 50 to 90% of children with asthma exhibit symptoms prior to five years of age (Martinez & Wright, 1995).

Dermatitis

The prevalence of dermatitis in children and adolescents ranges from 28% to 37% and has increased in recent years (Gupta, Sheikh, Strachan, & Anderson, 2004). Dermatitis is a broad term used to refer to inflammatory skin conditions with rash-like symptoms. Contact dermatitis and atopic dermatitis (i.e., eczema) are the most common types of dermatitis occurring in children and adolescents (Oranje & de Waard-van der Spek, 2002). These conditions are more common in African-Americans than Caucasians and affect more females than males with age of onset usually occurring during infancy and early childhood (Taylor, 2003).

The most common causes of contact dermatitis in children and adolescents include diaper substances (e.g., lotions, powders), plants (e.g., poison ivy, flowers), and metals (e.g., jewelry, belt buckles; Mortz & Andersen, 1999; Huntley, 1977). Atopic dermatitis most commonly affects the face, scalp, and limbs in children younger than two years of age, while joints (e.g., behind the knee, elbow) are the most frequently affected areas in children between the ages of two and eleven years. These areas are also affected in adolescents; however, the perimeter is smaller and may also include genitals (Kristal & Klein, 2000).

Food and Chemical Allergies

Approximately 6 to 10% of children have food allergies, and about 1.5 to 3% have chemical allergies, with prevalence rates increasing in recent years (see Sampson, 2004, for a review; Zeiger, 1999). Onset of food allergies most commonly occurs during infancy and early childhood (Ewan, 1996). The average age of onset for chemical allergies in the pediatric population is between 7 and 10 years of age (Kidon & See, 2004). Food and chemical allergies are more prevalent in boys than girls (Zeiger & Heller, 1995). Milk, eggs, wheat, seafood, and nuts are among the most common foods to which children and adolescents are allergic (Pascual, Crespo, Perez, & Esteban, 2000). Antibiotics (e.g., penicillin), non-steroidal anti-inflammatory drugs (e.g., Motrin, Advil), latex, cosmetics (e.g., perfume), and pesticides are among the most common chemicals to which children and adolescents are allergic (Kidon & See, 2004).

Comorbid Medical Illnesses and Anxiety

Anxiety disorders are one of the most common psychological conditions comorbid with medical illnesses (Sherbourne, Wells, Meredith, Jackson, & Camp, 1996; Pellock, 2004). Research has shown prevalence rates of anxiety disorders to be significantly higher in individuals with medical illnesses (e.g., cardiac conditions, epilepsy, gastrointestinal illnesses), and individuals with medical conditions have higher rates of anxiety disorders than healthy controls (see Zaubler & Katon, 1996, for a review). Subsyndromal anxiety (i.e., symptoms of anxiety which do not meet diagnostic criteria for a disorder) has also been found to negatively impact health and functioning in children with medical illnesses. Children and adolescents with comorbid anxiety disorders and medical conditions have been shown to be at a higher risk of developing mental health problems in adulthood, have poorer health outcomes, and experience more limitations in school and peer-related activities (Engstrom, 1999; Campo et al., 2001).

Knowledge of the comorbidity between anxiety and allergies in children and adolescents is especially important because these disorders generally begin during the period between infancy and late adolescence. Comorbid anxiety and allergies may have profound effects on daily functioning (e.g., going to school) and developmental milestones (e.g., making friends). Furthermore, the association between these conditions needs to be better understood for appropriate diagnosis and treatment. Most importantly this research is necessary for early identification of at risk children and to develop suitable intervention and prevention programs.

Review of Anxiety and Allergies Literature

The purpose of this review was to examine the available literature on comorbid anxiety and childhood allergies in children and adolescents. Attention is given to a description and methodological critique of the literature, followed by a discussion of theories which attempt to explain this comorbidity.

A literature review was performed using computerized databases, PsycArticles, PsycINFO, and MEDLINE, with groupings of the search term anxiety and the different types of allergic conditions (e.g., asthma, allergic rhinitis, dermatitis). The reference sections of applicable articles were also searched for additional literature to include in this review. The following inclusion criteria were used to select articles: (a) the study included assessment of anxiety symptoms or anxiety disorders in relation to allergic disorders, (b) studies with group designs, (c) articles available in the English language, (d) sample populations included infants, children, or adolescents.

Allergic Rhinitis and Anxiety

Hart, Lahey, Hund, Loeber, and McBurnett (1995) examined the association between allergic rhinitis and anxiety in 177 boys aged 7 to 12 years over a four year period. The researchers interviewed participants and collaterals, using the National Institute of Mental Health Diagnostic Interview Schedule for Children (DISC; Costello, Edelbrock, Kalas, & Duncan, 1984), modified to include criteria from the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) and the revised edition (DSM-III-R). These interviews were conducted once a year for four years. Parents were questioned about their child's health history and presence of allergic rhinitis during the first and second interviews. The number of children with and without allergic rhinitis was not specified.

The results showed a significant association between overanxious disorder (i.e., children who might meet criteria for generalized anxiety disorder or social anxiety disorder/social phobia according to DSM-IV criteria) and allergic rhinitis, with children who met criteria during all four years more likely to have allergic rhinitis than children who did not. There were no significant associations between other allergic conditions or psychological diagnoses, suggesting a specific association between overanxious disorder and allergic rhinitis. The authors hypothesized a biological explanation for the association between allergic rhinitis and anxiety according to the increasingly significant association between these two conditions over the four-year period. This hypothesis was based on the authors' suggestion that anxiety caused by environmental factors occurs in less acute forms, while chronic anxiety has a biological basis.

A group of researchers conducted longitudinal studies, focused on the biological and behavioral characteristics of children classified as inhibited (e.g., shy) or uninhibited (e.g., outgoing). These studies have shown an association between inhibited behavior (i.e., excessive withdrawal from novel events and people) during infancy and early childhood with allergy symptoms and family histories of hay fever (Reznick et al., 1986; Kagan, Snidman, Julia-Sellers, & Johnson, 1991). Shyness and inhibited behavior have been found to predict the development of anxiety disorders in children (Turner, Beidel, & Wolff, 1996). Reznick et al. (1986) assessed the behavior of 24 inhibited, 22 uninhibited, and 18 control children, based on classification from behavioral observations conducted in an earlier study (Garcia-Coll, Kagan, & Reznick, 1984). All of the participants were four years of age at the time of the study. Behavioral observations were conducted at two points in a laboratory setting and at two points in the child's school. The children's inhibited and uninhibited behavior, heart rate, and performance accuracy were assessed as they completed stressful cognitive tasks in the laboratory. Peer interactions were also observed in the laboratory and school settings. The participants' mothers were interviewed to assess the child's illness history and physiological symptoms. Inhibited children were more likely than the other children to avoid and withdraw from social interactions, experience excessive fears, and have chronic allergies and gastrointestinal problems during infancy.

Follow-up assessments were conducted on these participants at 5.5 and 7.5 years of age using behavioral observations, performance tasks, and physiological measures (Kagan, Reznick, & Snidman, 1987, 1988). Kagan et al. (1991) indicated that the inhibited children scored higher on the physiological measures (e.g., salivary coritsol, norepinephrine, and heart rate) than uninhibited children, and were more likely to have parent-reported histories of hay fever during their first three years of life. Kagan et al. (1991) conducted two studies to further examine the association between hay fever and behavioral inhibition. The sample used in the first study consisted of 48 inhibited and 41 uninhibited children identified by Garcia-Coll et al. (1984). In addition, 292 first and second degree relatives of the inhibited children and 236 first and second degree relatives of the uninhibited children also participated. Telephone interviews designed for the study were used to assess for social anxiety and histories of medical and psychological illnesses in the children's relatives. The results showed

that the relatives of inhibited children were more likely to report a history of hay fever and eczema than the relatives of uninhibited children. This was especially true for the fathers of inhibited children, with 36% reporting a history of hay fever compared to 16% of the fathers of uninhibited children. Relatives of inhibited children also scored higher than the relatives of uninhibited children on the social anxiety measure developed for the study.

In the second study, Kagan et al. (1991) attempted to partially replicate the findings from the first study, using 480 first and second degree relatives of 59 healthy infants. The same measures were used. Parental history of hay fever differed significantly between groups, with 32% of the inhibited infant's parents reporting a history of hay fever compared to 14% of uninhibited infant's parents. Furthermore, 64% of inhibited infants had at least one parent with hay fever compared to 25% of the uninhibited infants. Inhibited infant's relatives had significantly higher social anxiety scores at 11% compared to 1% of the uninhibited infant's relatives. Thus, 69% of the inhibited infants had at least one relative that reported experiencing symptoms of social anxiety compared to 11% of the uninhibited infants. High levels of social anxiety were correlated with allergies for all relatives. Based on findings from these studies, Reznick et al. (1986) and Kagan et al. (1991) theorized that both biological (e.g., neurochemicals and physiological structures) and environmental factors (e.g., parenting) play a role in the development of comorbid anxiety and allergies.

Asthma and Anxiety

Out of all childhood allergic conditions, asthma has the largest number of available research articles which examine the association between asthma and anxiety in children and adolescents. A recent review of asthma and anxiety disorders was conducted by Katon, Richardson, Lozano, and McCauley (2004). Katon et al. (2004) reviewed seven articles which examined the comorbidity of asthma and anxiety disorders in children and adolescents. The articles reviewed by Katon et al. (2004) generally showed high rates of comorbidity between asthma and anxiety in children and adolescents, especially between asthma and panic disorder (Bussing, Burket, & Kelleher, 1996; Craske, Poulton, Tsao, & Plotkin, 2001; Goodwin, Pine, & Hoven, 2003; Kashani, Konig, Sheperd, Wilfley, & Morris, 1988; Ortega, Huertas, Canino, Ramirez, & Rubio-Stipec, 2002; Vila, Nollet-Clemencon, De Blic, Mouren-Simeoni, & Scheinmann, 2000; Vila et al., 1999). See Table I for details on the research design, participants, data analysis procedures, and findings of these studies.

In addition to the studies reviewed by Katon et al. (2004), five research articles met criteria for the current literature review. Butz and Alexander (1993) assessed anxiety symptoms in 155 asthmatic children and their mothers. Participants were between 7 and 12 years of age and had visited the emergency department for an asthma attack within the past year. Home visits were conducted at two points during the eight-week period following the emergency department visit. The State-Trait Anxiety Inventory for Children (STAIC; Spielberger, Edwards, Lushene, Mounturi, & Platzek, 1973) and the State-Trait Anxiety Inventory Form Y (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) were administered to the children and their mothers respectively at the first home-visit. The mothers also completed demographic and illness history questionnaires at that time. During the follow-up visit, participants' mothers reported on the occurrence of asthma symptoms, hospitalizations, and activity limitations for the 8-week period. Mothers scored higher than their children on the STAI and child anxiety was significantly associated with a moderate number of parent-reported asthma attacks. Mothers of children with asthma-onset prior to age one scored higher on trait anxiety than mothers of children with later asthma-onset (36.1% vs. 11.1%). The authors concluded that maternal and child anxiety is highest immediately prior to an asthma attack and may be a learned response to anxiety-provoking stimuli associated with asthma attacks (e.g., difficulty breathing).

Gupta, Mitchell, Gluffre, and Crawford (2000) also used the STAI (Spielberger et al., 1973) to assess anxiety symptoms in mothers of 40 asthmatic children aged 6 to 17 years. These asthmatic children were compared to 39 children with congenital heart disease on the Fear Survey Schedule for Children – Revised (FSSC-R Ollendick, 1978), the Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1990), and the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983). Diagnoses and disease severity were reported by the physician. Children with asthma and children with congenital heart disease did not score significantly different from one another on the FSSC-R, RCMAS, or CBCL. Asthmatic children did

Table I. Previously Reviewed Child and Adolescent Asthma and Anxiety Study Designs and Results

First Author	Population and Sample Size	Healthy Control Group	Assessment Method	Asthma Diagnosis	Results
Bussing (1996)	Ages 7–17; 37 asthma; 25 healthy	Yes	Schedule for affective disorders and schizophrenia for school-age children (K-SADS)	Physician-report (including severity rating)	Children with asthma were two times as likely as healthy controls to have anxiety disorders, with separation anxiety disorder occurring most frequently
Craske (2001)	992 individuals; Ages 18 or 21 years followed from age 3	No	Diagnostic interview schedule (DIS); behavioral observations	Allergy testing	Asthma prior to age 18 predicted the later development of panic disorder and agoraphobia
Goodwin (2003)	Ages 9–17 years; Nationwide sample of 1285 children	Not reported	DIS for children (DISC); child global assessment scale (CGAS)	Parent-report (including severity rating)	Asthma increased the likelihood of panic attacks and asthma severity predicted the strength of the association between asthma and panic attacks
Kashani (1988)	Ages 7–16; 56 asthma; 56 other medical conditions	Yes	Diagnostic interview for children and adolescents; child behavior checklist (CBCL)	Physician-report	Non-significant trend for asthmatic children to self-report higher symptoms of psychopathology than control children. Parent-reports of children's anxiety symptoms were significantly higher than control children, especially for phobias
Vila (1999)	Ages 8–17 years; 93 asthma; 93 diabetes	Diabetes control group	K-SADS-R; CBCL; STAIC	Physician-report (including severity rating)	Children with asthma had higher overall rates of psychological problems than children with diabetes. 32% of the asthmatic children met diagnostic criteria for anxiety disorders, with generalized anxiety disorder occurring most frequently
Vila (2000)	Ages 8–17 years; 82 with asthma; 82 healthy	Yes	K-SADS-R; inventory of fears and anxiety	Physician-report	Children with asthma reported significantly more symptoms of anxiety than controls. 35% of asthmatic children were diagnosed with anxiety disorders, with generalized anxiety disorder being the most common. Asthmatic children were not more likely than controls to report symptoms of depression or low self-esteem
Ortega (2002)	Ages 9–17 years; Nationwide sample of 1285 children	Yes	DIS for children (DISC); child global assessment scale (CGAS)	Parent-report	A history of asthma was associated with anxiety disorders in 49.2% of asthmatics compared to 37% of healthy controls. Asthma was not associated with mood disorders and other chronic illnesses were not associated with anxiety disorders

score significantly higher than children with heart disease on the Medical Fears Subscale of the FSSC-R. Higher scores on the child-completed measures were associated with higher maternal scores on the STAI for both groups. Greater severity ratings were significantly associated with higher anxiety scores. The researchers hypothesized that maternal anxiety and familial factors (e.g., stress) played a role in the elevated anxiety symptom scores of children in both groups.

Ortega et al. (2003) examined the presence of asthma and various psychological disorders in a community sample of 1,890 Puerto Rican children. A questionnaire developed for the study was used to assess for asthma history, asthma attacks, or hospitalizations due to asthma. The DISC and the History of Family Psychopathology Questionnaire (Lish, Weissman, Adams, Hoven, & Bird, 1995) were used to assess for anxiety symptoms and anxiety disorders. Of the 1,890 children surveyed, 32% reported having physician-diagnosed asthma, 22% reported a history of asthma attacks, and 17% reported a history of hospitalization(s) for asthma. A significant association was found between psychopathology and asthma or a history of asthma attacks. Anxiety disorders and disruptive behavioral disorders were the most common psychological diagnoses associated with asthma. Ortega, McQuaid, Canino, Goodman, and Fritz (2004) further analyzed these data to examine the association between anxiety disorders and asthma. These researchers found that children with histories of asthma diagnoses reported experiencing significantly more physiological symptoms of generalized anxiety disorder and separation anxiety disorder.

Vila, Nollet-Clemencon, De Blic, Mouren-Simeoni, and Scheinmann (1998) assessed the presence of psychological conditions in 92 asthmatic children aged 8 to 17 years. Participants were recruited from an outpatient clinic in France and asthma diagnoses and severity ratings were provided by the physician. The participants' parents completed the CBCL and the Conner's Parent Rating Scale (CPRS; Goyette, Conners, & Ulrich, 1978), while each child completed the STAIC, the Children's Depression Inventory (CDI; Kovacs, 1985), and the Self-Esteem Inventory (SEI; Coopersmith, 1981). The researchers also interviewed participants with the Revised Schedule for Affective Disorders and Schizophrenia for School-Aged Children (KSADS-R; Chambers et al., 1985). Results demonstrated that moderate and severe-persistent asthma were significantly associated with psychological diagnoses. Anxiety disorders were more prevalent among children with moderate and severe asthma (36%) than children in the general population.

Wamboldt, Fritz, Mansell, McQuaid, and Klein (1998) attempted to clarify the association between asthma and psychopathology, using a sample of 337 children and adolescents. Asthma diagnoses and severity ratings were provided by the child's physician. Participants completed the RCMAS, CBCL, Asthma Functional Morbidity Measure (i.e., an assessment of asthma related functional limitations), and the Weinberger Adjustment Inventory (i.e., a measure of social and emotional adjustment; Weinberger, 1991). The participants also underwent IQ testing and their parents completed the Pennebaker Inventory of Linguid Languidness (PILL; Pennebaker, 1982) to assess frequency of health-related behaviors. Wamboldt et al. (1998) found a significant association between asthma severity and internalizing symptom scores on the CBCL for the parent-reports only. The researchers hypothesized that the parents' reports were influenced by their own symptoms of anxiety in relation to their child's asthma.

Dermatitis and Anxiety

Research on the association between anxiety and dermatitis in children and adolescents is limited. One research article on childhood dermatitis and symptoms of anxiety was available and met criteria for inclusion in this review. Sarkar et al. (2004) assessed psychopathology and behavioral problems in 22 Indian children with atopic dermatitis and 22 healthy controls aged 3 to 9 years, matched for age and gender. Participants' mothers completed the Personality Trait Inventory (PTI; Mahajan, Pershad, & Verma, 1990) and the Childhood Psychopathology Measurement Schedule (Anurima, Pershad, & Verma, 1990). The PTI was used to assess the mother's personality characteristics and mental health problems, while the Childhood Psychopathology Measurement Schedule evaluated the children's behavioral problems. Children with atopic dermatitis were almost three times as likely as controls to experience symptoms of anxiety and depression. The authors concluded that their study confirmed the association between dermatitis and psychological disorders.

Food and Chemical Allergies and Anxiety

Research is limited in the area of food and chemical allergies and anxiety in children and adolescents. One study on food allergies and anxiety in adolescents was available and met criteria for this review. Lyons and Forde (2004) evaluated the psychological effects of food allergies on 162 adolescents with a mean age of 16.7 years. Participants were recruited through a university and consisted of 136 females and 26 males. Participants completed questionnaires developed for the study regarding their history of food allergies and perceived health status. The STAI was used to assess participants' anxiety symptoms. Approximately 15% of the sample reported experiencing food allergies. Adolescents with a history of food allergies reported experiencing significantly more symptoms of anxiety than adolescents without food allergies. The authors concluded that food allergies may require afflicted individuals to fear and avoid foods that could cause an allergic reaction, which may increase feelings of anxiety.

Nonspecified Allergies and Anxiety

Two studies were found which examined the association between anxiety and allergies in children and adolescents but did not specify the type of allergic conditions. Slattery et al. (2002) studied the association between childhood allergies, parent anxiety, and child anxiety in 343 children aged 6 to 17 years. Parental psychopathology was assessed using the Structured Clinical Interview for *DSM-IV* (SCID; First, Spitzer, Gibbon, & Williams, 1995; Spitzer, Williams, Gibbon, & First, 1992). Children were assessed for psychological disorders, using the Parent as Respondent Informant Schedule (PARIS; Klein & Muzza, 1992; Kentgen, Klein, Mannuzza, & Davies, 1997). Parents reported their child's allergy history. Children of panic disordered parents had significantly higher rates of allergic conditions than children of parents without panic disorder. Compared to parents with other psychological diagnoses, parents with panic disorder were significantly more likely to have allergies. Children with separation anxiety disorder were significantly more likely than controls to experience allergies. These associations were shown to be significant with no interaction between child and parent psychopathology. The authors concluded that childhood separation anxiety and parental panic disorder play independent roles in escalating rates of childhood allergic conditions.

Kovalenko et al. (2001) examined allergic conditions in relation to psychological disorders in 2,221 children aged 9 to 17 years. Children were interviewed using the DISC and parents indicated their child's history of allergic symptoms during the Service Utilization and Risk Factors Interview (Goodman et al., 1998). A significant association was found between allergies and anxiety disorders. Forty percent of the children with histories of allergies were diagnosed with comorbid anxiety disorders and 69% of patients with panic disorder reported symptoms of allergies. The authors concluded that these findings replicated and extended the available literature on adults to a pediatric sample.

Critique of Anxiety and Allergies Literature

Sample Selection

The majority of the studies reported recruiting participants from allergy clinics and hospitals. Only five of the reviewed studies used community-based samples (Craske et al., 2001; Kovalenko et al., 2001; Kagan et al., 1991; Reznick et al., 1986; Ortega et al., 2004). One problem with restricting participant recruitment to clinical settings is limited generalizability of findings. Individuals who actively seek treatment may have more severe allergies than individuals who do not. Finally, individuals who do not willingly seek allergy treatment may have qualitatively different psychological problems than individuals who seek treatment.

Age

The reviewed studies included samples of children and adolescents ranging in age from 6 to 20 years. Only three of the studies investigated the association between allergies and anxiety in infants and children under the age of six years (Reznick et al., 1986; Kagan et al., 1991; Sarkar et al., 2004). Infants and young children are particularly important to study because many allergies manifest during this age range. Furthermore, research on this age group can be used to identify the developmental pathway of comorbid anxiety and allergies, target at-risk infants and children, and develop appropriate prevention and intervention programs. Self-report measures

cannot be used with this group; however, other assessment methods have been used successfully with this group (e.g., Kagan & Snidman, 1999).

Sample Matching

Group studies often include participant matching on demographic characteristics (e.g., age, gender) to rule out the possibility that variables unique to the participants account for group differences. This is especially important, considering previous literature which has demonstrated that socioeconomic status, gender, and ethnicity are related to the respective development of anxiety disorders and allergic conditions (e.g., Salam et al., 2004). Participant matching is also used to reduce the risk of type II errors by homogenizing the sample (Schmelzer, 2000). Only three of the studies included in this review used participant matching on variables, such as age and gender (Sarkar et al., 2004; Kashani et al., 1987; Bussing et al., 1996). It is important to note that other statistical methods can be used to control for demographic variables. Six of the reviewed studies reported using these methods, including regression models, analyses of variance, t-tests, and analyses of covariates (Wamboldt et al., 1998; Vila et al., 1999; Kovalenko et al., 2000; Craske et al., 2001; Gupta et al., 2000; Butz & Alexander, 1993).

Self-Reports

The majority of the studies used self-report measures of anxiety. Self-report measures provide valuable information that often cannot be observed or easily measured (e.g., worries, fears), however, the self-report of behavior has been shown to be biased (Ederer, 2004). Self-report biases include presenting oneself in a socially desirable fashion and providing answers that reduce the likelihood of criticism (Steele, Phipps, & Srivastava, 1999). Furthermore, the use of only one type of measure to assess a construct is problematic because it limits the validity of conclusions that can be drawn.

Assessment Measures

The STAI was one of the most commonly used measures of anxiety in this literature, as it was employed in five of the reviewed studies (Vila et al., 1998; Butz & Alexander, 1993; Lyons & Forde, 2004; Gupta et al., 2000). Some form of the STAI (e.g., child-report, parent-report) was used as the sole measure of anxiety in six of these studies, whereas Vila et al. (1998, 1999) and Gupta et al. (2000) used the STAI in combination with other standardized measures of anxiety. Use of the STAI as the only measure of anxiety is problematic because research has shown that the trait and state subscales have questionable construct validity (Tenenbaum, Furst, & Weingarten, 1985).

Allergy Measures

A serious limitation of this research is the vast differences in criteria used to determine the presence of an allergy. Two studies employed allergy testing and a standardized criterion for determining a diagnosis (e.g., IgE levels; Craske et al., 2001; Sarkar et al., 2004). Seven studies used self-report or parent-report as the sole measure of allergies and allergy histories (Kovalenko et al., 2001; Slattery et al., 2002; Hart et al., 1995; Kagan et al., 1991; Ortega et al., 2004; Reznick et al., 1986; Goodwin et al., 2003). Butz and Alexander (1993) used chart reviews to determine the presence of allergies.

Allergy Severity

Only six studies controlled for allergy severity (Bussing et al., 1996; Goodwin et al., 2003; Wamboldt et al., 1998; Vila et al., 1998; Gupta et al., 2000). These authors generally demonstrated that moderate to severe allergies predicted a stronger association between allergies and anxiety. This shows that it is important to include these ratings to better understand the association between anxiety and allergies.

Allergies as a Group

Although many of the reviewed studies examined the association between a specific allergy (e.g., asthma) and anxiety, two studies grouped several allergic conditions (Slattery et al., 2002; Kovalenko et al., 2001). Specifying the allergic condition associated with anxiety allows for an examination of

disease-specific factors that may play a role in the development of these comorbid conditions. For example, Craske et al. (2001) and Goodwin et al. (2003) demonstrated a specific association between asthma and panic disorder, while Hart et al. (1995) showed that allergic rhinitis was specifically related to overanxious disorder. This has implications for treatment. The specific features of allergies associated with anxiety may require different treatment strategies.

Design Limitations

Only five studies used longitudinal designs (Hart et al., 1995; Reznick et al., 1986; Kagan, 1991; Craske et al., 2001; Butz & Alexander, 1993). Cross-sectional designs allow for correlating variables but limit our knowledge of the association between allergies and anxiety because they cannot be used to determine causal relations. Longitudinal studies allow for an understanding of how allergies and anxiety are related and how these comorbid conditions develop. For example, Crask et al. (2001) demonstrated that childhood asthma predicted the development of panic disorder in early adulthood.

Discrepancies Between Studies

Despite differences in study designs, assessment methods, sample size, and participant selection, the vast majority of the studies reviewed demonstrated a consistent association between allergies and anxiety. It is important to note that two of the reviewed studies included comparison groups of children with chronic illnesses other than allergies and obtained different results from one another. Gupta et al. (2000) compared asthmatic children to children with congenital heart disease, while Vila et al. (1999) compared asthmatic children to children with diabetes. Gupta et al. (2000) found that asthmatic children did not score significantly different from children with heart disease on measures of anxiety; however they did differ on the Medical Fears Subscale of the FSSC-R. Vila et al. (1999) used two of the same measures of anxiety (i.e., CBCL and STAIC); however, these researchers found that asthmatic children obtained significantly higher scores on these measures than diabetic children. One possible explanation for these findings is that Vila et al. (1999) matched participants on sociodemographic variables whereas Gupta et al. (2000) did not. Thus, the findings may have been reflective of variables unique to the participants rather than the condition. Characteristics of the conditions (e.g., severity, treatment regimens) may also have accounted for differences in findings. Although the reviewed studies examined the comorbidity between anxiety and allergies, none of the reviewed studies demonstrated a causal relation. Some theories have been developed to explain how anxiety and allergies are related, however, further studies are warranted to evaluate the validity of these.

Theories of the Association Between Anxiety and Allergies

Literature which explains the association between allergies and anxiety is limited. Two types of theories have been proposed to explain the association between anxiety and allergies, which include biological and cognitive-behavioral theories.

Biological Theories

One biological theory is that allergies and anxiety disorders have specific structural and neurochemical processes in common. Based on evidence that shy and inhibited children have greater sympathetic nervous system activity, allergies and anxious behavior (e.g., withdrawal) have been linked to the limbic system and the hypothalamic pituitary adrenal axis (Kagan et al., 1987, 1988; Arcus, 1994). The limbic system is involved in regulating emotions and is connected to the hypothalamic pituitary adrenal axis which is responsible for controlling responses to stress (Matthew et al., 2001). Specifically, it has been hypothesized that alpha melanocyte-stimulating hormones, a group of chemicals located in the limbic system, is bidirectionaly related to allergic reactions and temperament (Arcus, 1994; Raap et al., 2003).

Miller and Wood (1997) examined autonomic nervous system activity in asthmatic children exposed to emotion-provoking movie scenes. The results demonstrated that sad movie scenes correlated with autonomic nervous system activity that restricted the airway, similar to an asthma attack, while happy movie scenes were not. Consistent with Arcus (1994), Kagan et al. (1987, 1988), and Raap et al. (2003), Miller and Wood (1997) hypothesized that emotional states influence physiological reactions which are moderated by tempermental factors. The reviewed studies conducted by Reznick et al.

(1986) and Kagan et al. (1991) support this biological theory, in that sympathetic nervous activity was significantly higher in inhibited children with reported histories of allergies.

A second biological theory is that anxiety and allergic disorders are genetically linked. Evidence to support this includes greater associations between allergies and internalizing symptoms in monozygotic (i.e., identical) than dyzygotic (i.e., fraternal) twins (Wamboldt et al., 2000). Genetic links have been shown to explain more than 75% of the covariance between allergies and symptoms of psychopathology in twin siblings (Wamboldt, Schmitz, & Mrazek, 1998). It has specifically been hypothesized that 5HTT, a gene responsible for transmitting the neurochemical serotonin to and from cells in the brain, plays a role in determining immunological and psychological reactions (e.g., stress, depression; Timonen et al. 2003). This theory is consistent with the reviewed studies by Slattery et al. (2002) and Kagan et al. (1991), in which parents and family members of children with comorbid anxiety and allergies were more likely to have a history of allergies than controls.

Cognitive-Behavioral Theories

Cognitive-behavioral theories emphasize the role of learning in the development of comorbid allergies and anxiety disorders. One cognitive-behavioral theory posits that classical conditioning explains the association between anxiety and allergies, in which children and adolescents who experience symptoms of an allergic reaction (i.e., unconditioned stimulus) fear the recurrence of these symptoms. The child then experiences feelings of anxiety and fear (i.e., conditioned response) in relation to symptoms associated with an allergic reaction (i.e., conditioned stimulus; Carr, 1997; Feldman et al. 2000; Reznick et al., 1986). This theory may be most applicable to the comorbidity between asthma and panic disorder. Specifically, asthma and panic disorder share similar respiratory symptoms and behavioral avoidance of symptom triggers (Feldman et al., 2000). Two of the reviewed studies provided evidence which supports this concept. Craske et al. (2001) demonstrated that asthma history plays a role in the development of panic disorder and agoraphobia, and Goodwin et al. (2003) showed that asthma predicted the occurrence of panic attacks.

Another cognitive-behavioral explanation of comorbid anxiety and allergies involves learning and parental modeling. This theory proposes that parents model maladaptive coping skills and responses to anxiety-provoking allergy related variables (e.g., administering treatment) and exhibit overprotective behavior to reduce feelings of fear (Bender et al., 2000; Mrazek, Schuman, & Klinnert, 1998). The child then learns maladaptive coping skills and develops anxious responding to stimuli. Results from the reviewed studies by Butz and Alexander (1993), Bussing et al. (1996), and Slattery et al. (2002), demonstrated that children may model their parents' anxious responses to allergy-related stimuli. Furthermore, Gupta et al. (2000) and Wamboldt et al. (1998) provided evidence that high levels of maternal anxiety played a role in increasing child anxiety.

Synthesis of Theories

The available theories explaining the association between anxiety and allergies include cognitive-behavioral and biological models. It is important to note that these theories have limited empirical support, warranting further research. Systematic replication is required to provide supporting evidence for these theories. None of the theories provides a causal direction of influence. Rather, both biological and cognitive-behavioral factors have been discussed in terms of bidirectional effects on allergies and anxiety. Thus, a biopsychosocial model may be the most appropriate available explanation of comorbid allergies and anxiety, in which biological and environmental factors influence one another. Taken together, the reviewed studies demonstrate that neurochemical processes (e.g., sympathetic nervous system activity) and parental influences (e.g., modeling anxious responding) play a role in the development of comorbid anxiety and allergies.

Conclusions and Future Directions

The overall finding of an association between anxiety symptoms or anxiety disorders and allergies in children and adolescents is fairly consistent across several studies despite differences and limitations in methodology. The available research, however, is very limited in the specific areas of food and chemical allergies, and dermatitis and anxiety in children and adolescents. These allergies should be the focus of

future examinations of allergies and anxiety in children and adolescents. This would add to the limited literature in this area and demonstrate whether the association between allergies and anxiety differs based on the specific allergic condition that is studied. In addition, young children and infants should be included in future studies to assist with identifying the developmental pathways of comorbid anxiety and allergies.

Future studies should also incorporate participant recruitment from both community and clinical samples to improve the generalizability and validity of findings. The use of participant matching on various demographic variables would also increase the generalizability and validity of finding and assist with eliminating confounding variables that are unique to participant characteristics (e.g., socioeconomic status). Multiinformant and multimethod assessment should be used to rule out the possibility that measurement errors account for study findings. The use of standardized and well validated measures of anxiety is also necessary to achieve this goal.

It is recommended that criterion-based measures be used to increase the validity of findings to increase the validity of findings across studies. Furthermore, the inclusion of allergy severity ratings might provide information on disease-specific variables that contribute to the association between anxiety and allergies. Two studies compared children with allergies to children with other chronic illnesses on measures of anxiety (Gupta et al., 2000; Vila et al., 1999). Inclusion of comparison groups of children with other medical illnesses may elicit the specific aspects of allergic conditions that are related to anxiety disorders. Family functioning has been shown to play a role in the respective development of anxiety disorders and allergies. Specific aspects of family functioning that have been associated with these conditions include communication, problem-solving approaches, disciplinary practices, conflict, and family cohesiveness (Sawyer, Spurrier, Kennedy, & Martin, 2001; Bender et al., 2000; Ginsburg, Siqueland, Masia-Warner, & Hedtke, 2004). Future studies should examine the role of these specific family functioning factors in children with comorbid anxiety and allergies to better understand how this comorbidity develops.

It is also necessary to investigate specifically how comorbid allergies and anxiety impact children and adolescent's functioning to appropriately address these issues clinically. Longitudinal designs are crucial for understanding how allergies and anxiety are causally related. This knowledge might allow for the identification of at-risk children and adolescents, and the development of appropriate intervention and prevention programs. The association between these conditions might also be better understood through the study of resilience. This includes identifying factors unique to children who are not diagnosed with these comorbid conditions. This could be studied by comparing groups of children with comorbid anxiety and allergies to children with either condition alone, and healthy controls. Finally, treatment studies might shed light on the association between anxiety and allergies to establish whether a reduction in symptoms of one disorder results in decreased symptoms in the other disorder.

Some suggestions for clinical application of this work include implementing early interventions to reduce negative impacts on functioning and development. Although further work is needed to adequately identify at-risk children, clinicians and health workers should conduct appropriate assessments for comorbid anxiety symptoms or disorders and allergies in children and adolescents with family histories of these conditions. Based on the cognitive-behavioral theories of these disorders, it may also be beneficial to target anxious parents and to implement exposure treatments that reduce fear associated with the physiological symptoms of allergic reactions.

Acknowledgments

The authors thank professors Andy Lopez-Williams, PhD and Cheryl McNeil, PhD for their comments on an earlier draft of this manuscript.

References

Achenbach, T. M., & Edelbrock, C. (1983). *Manual for the child behavior checklist and revised child behavior profile*. University of Vermont.

Akinbami, L. J., & Schoendorf, K. C. (2002). Trends in childhood asthma: Prevalence, health care utilization, and mortality. *Pediatrics*, *110*, 315–323.

Akinbami, L. J., Schoendorf, K. C., & Parker, J. (2003). US childhood asthma prevalence estimates: The impact of the 1997 national health interview survey redesign. *American Journal of Epidemiology*, *158*, 99–104.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders, 4th edition-text revision*. Washington, DC: American Psychiatric Association.

Anurima Pershad, D., & Verma, S. K. (1990). Validity of Hindi shortened version of PTI. *Mind*, *16*, 14–18.

Arcus, D. (1994). Biological mechanisms and personality: Evidence from shy children. *Advances: The Journal of Mind-Body Health*, *10*, 40–49.

Bellanti, J. A., & Wallerstedt, D. B. (2000). Allergic rhinitis update: Epidemiology and natural history. *Allergy and Asthma Proceedings*, *21*, 367–370.

Bender, B. G., Annett, R. D., Ikle, D., DuHamel, T. R., Rand, C., & Strunk, R. C. (2000). Relationship between disease and psychological adaptation in children in the childhood asthma management program and their families. *Archives of Pediatrics and Adolescent Medicine*, *154*, 706–713.

Bussing, R., Burket, R. C., & Kelleher, E. T. (1996). Prevalenc of anxiety disorders in a clinic-based sample of pediatric asthma patients. *Psychosomatics*, *37*, 108–115.

Butz, A. M., & Alexander, C. (1993). Anxiety in children with asthma. *Journal of Asthma*, *30*, 199–209.

Campo, J. V., Di Lorenzo, C., Chiappetta, L., Bridge, J., Colborn, D. K., Gartner, J. C. et al. (2001). Adult outcomes of pediatric recurrent abdominal pain: Do they just grow out of it? *Pediatrics*, *108*, 1–7.

Carr, R. E. (1998). Panic disorder and asthma: Causes, effects, and research implications. *Journal of Psychosomatic Research*, *44*, 43–52.

Chambers, W. J., Puig-Antich, J., Hirsch, M., Paez, P., Ambrosini, P. J., Tabrizi, M. A. et al. (1985). The assessment of affective disorders in children and adolescents by semistructured interview: Test-retest reliability of the schedule for affective disorders and schizophrenia for school-age children, present episode version. *Archives of General Psychiatry*, *42*, 696–702.

Coopersmith, S. (1981). *Self-esteem inventory*. California: Consulting Psychologist Press.

Costello, A. J., Edelbrock, C., Kalas, R., & Duncan, M. (1984). *The NIMH Diagnostic Interview Schedule for Children (DISC): Development, reliability, and comparison between clinical and lay interviewer*. Worcester, MA: University of Massachusetts Medical School.

Craske, M. G., Poulton, R., Tsao, J. C. I., & Plotkin, D. (2000). Paths to panic disorder/agoraphobia: An exploratory analysis from age 3 to 21 in an unselected birth cohort. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 556–563.

Ederer, E. M. (2004). Mental health problems in young children: Self-reports and significant others as informants. *Psychology Science*, *46*, 123–140.

Engstrom, I. (1999). Inflammatory bowel disease in children and adolescents: Mental health and family functioning. *Journal of Pediatric Gastroenterology and Nutrition*, *28*, S28–S33.

Ewan, P. W. (1996). Clinical study of peanut and nut allergy in 62 consecutive patients: New features and associations. *British Medical Journal*, *312*, 1074–1078.

Feldman, J. M., Giardino, N. D., & Lehrer, P. M. (2000). Asthma and panic disorder. In D. I. Mostofsky & D. H. Barlow (Eds.), *The management of stress and anxiety in medical disorders* (pp. 220–239). Massachusetts: Allyn and Bacon.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W.. (1995). *Structured clinical interview for DAM-IV axis 1 disorders* (*SCID*). New York: New York State Psychiatric Institute.

Garcia-Coll, C., Kagan, J., & Reznick, J. S. (1984). Behavioral inhibition in young children. *Child Development*, *55*, 1005–1019.

Ginsburg, G. S., Siqueland, L., Masia-Warner, C., & Hedtke, K. A. (2004). Anxiety disorders in children: Family Matters. *Cognitive and Behavioral Practice*, *11*, 28–43.

Goodman, S. H., Hoven, C. W., Narrow, W. E., Cohen, P., Fielding, B., Alegria, M., et al. (1998). Measurement of risk for mental disorders and competence in a psychiatric epidemiologic community survey: The NIMH methods for the epidemiology of child and adolescent mental disorders (MECA) study. *Social Psychiatry and Psychiatric Epidemiology*, *33*, 162–173.

Goodwin, R. D., Pine, D. S., & Hoven, C. W. (2003). Asthma and panic attacks among youth in the community. *Journal of Asthma*, *40*, 139–145.

Goyette, C. H., Conners, C. K., & Ulrich, R. F. (1978). Normative data on revised conners parent teacher rating scales. *Journal of Abnormal Child Psychology*, 221–236.

Gupta, S., Mitchell, I., Gluffre, R., & Crawford, S. (2000). Covert fears and anxiety in asthma and congenital heart disease. *Child: Care, Health, and Development*, *27*, 335–348.

Gupta, R., Sheikh, A., Strachan, D. P., & Anderson, H. R. (2004). Burden of allergic disease in the UK: Secondary analyses of national databases. *Clinical and Experimental Allergy*, *34*, 520–526.

Hajat, S., Haines, A., Atkinson, R. W., Bremner, S. A., Anderson, H. R., & Emberlin, J. (2001). Association between air pollution and daily consultations with general practitioners for allergic rhinitis in London, United Kingdom. *American Journal of Epidemiology*, *153*, 704–714.

Hart, E. L., Lahey, B. B., Hynd, G. W., Loeber, R., & McBurnett, K. (1995). Association of chronic overanxious disorder with atopic rhinitis in boys: A four-year longitudinal study. *Journal of Clinical Child Psychology*, *24*, 332–337.

Huntley, C. C. (1977). Atopic dermatitis and contact dermatitis in children. *American Family Physician*, *16*, 111–118.

Kagan, J., Reznick, J. S., & Snidman, N. (1987). The physiology and psychology of behavioral inhibition in children. *Child Development*, *58*, 1459–1473.

Kagan, J., Reznick, J. S., & Snidman, N. (1988). Biological bases of childhood shyness. *Science*, *240*, 167–171.

Kagan, J., & Snidman, N. (1999). Early childhood predictors of adult anxiety disorders. *Biological Psychiatry*, *46*, 1536–1541.

Kagan, J., Snidman, N., Julia-Sellers, M., & Johnson, M. O. (1991). Temperament and allergic symptoms. *Psychosomatic Medicine*, *53*, 332–340.

Kashani, J., Konig, P., Sheperd, J., Wilfley, D., & Morris, D. (1988). Psychopathology and self-concept in asthmatic children. *Journal of Pediatric Psychology*, *13*, 509–520.

Katon, W. J., Richardson, L., Lozano, P., & McCauley, E. (2004). The relationship of asthma and anxiety disorders. *Psychosomatic Medicine*, *66*, 349–355.

Kentgen, L. M., Klein, R. G., Mannuzza, S., & Davies, M. (1997). Test-retest reliability of maternal reports of lifetime mental disorders in their children. *Journal of Abnormal Psychology*, *23*, 389–398.

Kidon, M. I., & See, Y. (2004). Adverse drug reactions in Singaporean children. *Singapore Medical Journal*, *45*, 574–577.

Klein, R. G., & Muzza, S. (1992). *Parent as respondent informant schedule: PARIS*. New York: New York State Psychiatric Institute.

Kovacs, M. (1985). The children's depression inventory (CDI). *Psychopharmacology Bulletin*, *21*, 995–998.

Kovalenko, P. A., Hoven, C. W., Wu, P., Wicks, J., Mandell, D. J., & Tiet, Q. (2001). Association between allergy and anxiety disorders in youth. *Australian and New Zealand Journal of Psychiatry*, *35*, 815–821.

Kristal, L., & Klein, P. A. (2000). Atopic dermatitis in infants and children: An update. *Pediatric Clinics of North America*, *47*, 877–895.

Lish, J. D., Weissman, M. M., Adams, P. B., Hoven, C. W., & Bird, H. (1995). Family psychiatric screening instruments for epidemiologic studies: Pilot testing and validation. *Psychiatry Research*, *57*, 169–180.

Lyons, A. C., & Forde, E. M. E. (2004). Food allergy in young adults: Perceptions and psychological effects. *Journal of Health Psychology*, *9*, 497–504.

Mahajan, A., Pershad, D., & Verma, S. (1990). Personality trait inventory: An evaluation. *Journal of Personality and Clinical Studies*, *6*, 134–138.

Martinez, F. D., & Wright, A. L. (1995). Asthma and wheezing in the first six years of life. *New England Journal of Medicine*, *332*, 133–138.

Matthew, S. J., Coplan, J. D., Schoepp, D. D., Smith, E. L., Rosenblum, L. A., & Gorman, J. M. (2001). Glutamate-hypothalamic-pituitary-adrenal-axis interactions: Implications for mood and anxiety disorders. *CNS Spectrums*, *6*, 555–564.

Miller, B. D., & Wood, B. L. (1997). Influence of specific emotional states on autonomic reactivity and pulmonary function in asthmatic children. *Journal of the American Academy of Child and Adolescent Psychiatry*, *36*, 669–677.

Mortz, C. G., & Andersen, K. E. (1999). Allergic contact dermatitis in children and adolescents. *Contact Dermatitis*, *41*, 121–130.

Moss, M. H., & Lemanske, R. F. (1999). Increasing prevalence of hay fever and atopy among children in Lepzig, East Germany. *Pediatrics*, *104*, 360–361

Mrazek, D. A., Schuman, W. B., & Klinnert, M. (1998). Early asthma onset: Risk of emotional and behavioral difficulties. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*, 247–254.

National Center for Health Statistics (2002). *Summary health statistics for U. S. children: National health interview survey*, 2002, 221, 1–87.

Nettis, E., Colanardi, M. C., Ferrannini, A., & Tursi, A. (2004). Immune tolerance to drugs (II): Long-term tolerability of nimesulide in patients with NSAID hypersensitivity. *Immunopharmacology and Immunotoxicology*, *26*, 469–480.

Newacheck, P. W., & Taylor, W. R. (1992). Childhood chronic illness: Prevalence, severity, and impact. *American Journal of Public Health*, *82*, 364–371.

Ollendick, T. H. (1978). The fear survey schedule for children-revised. Unpublished manuscript, Indiana State University.

Oranje, A. P., & de Waard-van der Spek, F. B. (2002). Atopic dermatitis: Review 2000 to January 2001. *Current Opinion in Pediatrics*, *14*, 410–413.

Ortega, A. N., Huertas, S. E., Canino, G., Ramirez, R., & Rubio-Stipec, M. (2002). Childhood asthma, chronic illness, and psychiatric disorders. *Journal of Nervous and Mental Disease*, *190*, 275–281.

Ortega, A. N., McQuaid, E. L., Canino, G., Goodwin, R. D., & Fritz, G. K. (2004). Comorbidity of asthma and anxiety and depression in Puerto Rican children. *Psychosomatics*, *45*, 93–99.

Ortega, A. N., McQuaid, E. L., Canino, G., Ramirez, R., Fritz, G. K., & Klein, R. B. (2003). Association of psychiatric disorders and different indicators of asthma in island Puerto Rican children. *Social Psychiatry and Psychiatric Epidemiology*, *38*, 220–226.

Pascual, C. Y., Crespo, J. F., Perez, P. G., & Esteban, M. M. (2000). Food allergy and intolerance in children and adolescents: An update. *European Journal of Clinical Nutrition*, *54*, S75–S78.

Pellock, J. M. (2004). Understanding co-morbidities affecting children with epilepsy. *Neurology*, *62*, S17–S23.

Pennebaker, J. W. (1982). *The psychology of physical symptoms*. New York: Springer-Verlag.

Raap, U., Brzoska, T., Sohl, S., Path, G., Emmel, J., & Herz, U. (2003). Alpha melanocyte-stimulating hormone inhibits allergic airway inflammation. *The Journal of Immunology*, *181*, 353–359.

Reynolds, C. R., & Richmond, B. O. (1990). *Revised children's manifest anxiety scale*. California: Western Psychological Services.

Reznick, J. S., Kagan, J., Snidman, N., Gersten, M., Baak, K., & Rosenberg, A. (1986). Inhibited and uninhibited children: A follow-up study. *Child Development*, *57*, 660–680.

Salam, M. T., Li, Y., Langholz, B., & Gilliland, F. D. (2004). Early-life environmental risk factors for asthma: Finding's from the children's health study. *Environmental Health Perspectives*, *112*, 760–765.

Sampson, H. A. (2004). Update on food allergy. *Journal of Allergy and Clinical Immunology*, *113*, 805–819.

Sarkar, R., Raj, L., Kaur, H., Basu, S., Kanwar, A. J., & Jain, R. K. (2004). Psychological disturbances in indian children with atopic eczema. *Journal of Dermatology*, *31*, 448–454.

Sawyer, M. G., Spurrier, N., Kennedy, D., & Martin, J. (2001). The relationship between the quality of life of children with asthma and family functioning. *Journal of Asthma*, *38*, 279–284.

Schmelzer, M. (2000). Understanding the research methodology: Should we trust the researcher's conclusions? *Gastroenterology Nursing*, *23*, 269–274.

Schoenwetter, W. F. (2000). Allergic rhinitis: Epidemiology and natural history. *Allergy and Asthma Proceedings*, *21*, 1–6.

Sherbourne, C. D., Wells, K. B., Meredith, L. A., Jackson, C. A., & Camp, P. (1996). Comorbid anxiety disorder and the functioning and well-being of chronically ill patients of general medical providers. *Archives of General Psychiatry*, *53*, 889–904.

Slattery, M. J., Klein, D. F., Mannuzza, S., Moulton, J. L., Pine, D. S., & Klein, R. G. (2002). Relationship between separation anxiety disorder, parental panic disorder, and atopic disorders in children: A controlled high-risk study. *Journal of the American Acadmey of Child and Adolescent Psychiatry*, *41*, 947–954.

Spielberger, C. D., Edwards, C. D., Lushene, R. E., Mounturi, & Platzek, D. (1973). *STAIC preliminary manual for the state-trait anxiety inventory for children ("how i feel questionairre")*. California: Consulting Psychologists Press.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory* (*STAI form Y*). California: Consulting Psychologists Press.

Spitzer, R. L., Williams, J. B., Gibbon, M., & First, M. B. (1992). The structured clinical interview for *DSM-III-R* (SCID). *Archives of General Psychiatry*, *49*, 624–629.

Steele, R. G., Phipps, S., & Srivastava, D. K. (1999). Low-end specificity of childhood measures of emotional distress: Consistent effects for anxiety and depressive symptoms in a nonclinical population. *Journal of Personality Assessment*, *73*, 276–289.

Stone, K. D. (2003). Atopic diseases of childhood. *Current Opinion in Pediatrics*, *15*, 495–511.

Taylor, S. C. (2003). Epidemiology of skin diseases in ethnic populations. *Dermatologic Clinics*, *21*, 601–607.

Tenenbaum, G., Furst, D., & Weingarten, G. (1985). A statistical reevaluation of the STAI anxiety questionnaire. *Journal of Clinical Psychology*, *41*, 239–244.

Timonen, M., Jokelainen, J., Hakko, H., Silvennoinen-Kassinen, S., Meyer-Rochow, V. B., & Herva, A. (2003). Atopy and depression: Results from the Northern Finland 1966 birth cohort study. *Molecular Psychiatry*, *8*, 738–744.

Turner, S. M., Beidel, D. C., & Wolff, P. L. (1996). Is behavioral inhibition related to the anxiety disorders? *Clinical Psychology Review*, *16*, 157–172.

Vila, G., Nollet-Clemencon, C., De Blic, J., Mouren-Simeoni, M., & Scheinmann, P. (1998). Asthma severity and psychopathology in a tertiary care department for children and adolescent. *European Child and Adolescent Psychiatry*, *7*, 137–144.

Vila, G., Nollet-Clemencon, C., De Blic, J., Mouren-Simeoni, M., & Scheinmann, P. (2000). Prevalence of DSM-IV anxiety and affective disorders in a pediatric population of asthmatic children and adolescents. *Journal of Affective Disorders*, *58*, 223–231.

Vila, G., Nollet-Clemencon, C., Vera, M., Robert, J. J., de Blic, J., Jouvent, R., et al. (1999). Prevalence of DSM-IV disorders in children and adolescents with asthma versus diabetes. *Canadian Journal of Psychiatry*, *44*, 562–569.

Wamboldt, M. Z., Fritz, G., Mansell, A., McQuaid, E. L., & Klein, R. B. (1998). Relationship of asthma severity and psychological problems in children. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37*, 943–950.

Wamboldt, M. Z., Hewitt, J. H., Schmitz, S., Wamboldt, F. S., Rasanen, M., Koskenvuo, M., et al. (2000). Familial association between allergic disorders and depression in adult Finnish twins. *American Journal of Medical Genetics*, *96*, 146–153.

Wamboldt, M. Z., Schmitz, S., & Mrazek, D. (1998). Genetic association between atopy and behavioral symptoms in middle childhood. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *39*, 1007–1016.

Weinberger, D. (1991). The construct validity of the repressive coping style. In J. Singer (Ed.), *Repression and dissociation: Implications for personality theory, psychopathology, and health* (pp. 337–386). Illinois: University of Chicao Press.

Wright, A. L., Holberg, C. J., Martinez, F. D., Halonen, M., Morgan, W., & Taussig, L. M. (1994). Epidemiology of physician-diagnosed allergic rhinitis in childhood. *Pediatrics*, *94*, 895–901.

Zaubler, T. S., & Katon, W. (1996). Panic disorder and medical comorbidity: A review of the medical and psychiatric literature. *Bulletin of the Menninger Clinic*, *60*, A12–A38.

Zeiger, R. S. (1999). Prevention of food allergy in infants and children. *Immunology and Allergy Clinics of North America*, *19*, 619–646.

Zeiger, R. S., & Heller, S. (1995). The development and prediction of atopy in high-risk children: Follow-up at age seven years in a prospective randomized study of combined maternal and infant food allergen avoidance. *Journal of Allergy and Clinical Immunology*, *95*, 1179–1190.