

# Attention deficit-hyperactivity disorder is associated with allergic symptoms and low levels of hemoglobin and serotonin

Wang LJ, Yu YH, Fu ML, Yeh WT, Hsu JL, Yang YH, Chen WJ, Chiang BL, Pan WH.

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## Abstract

This study investigated whether common comorbidities or biochemical factors, such as allergic disease, anemia, inflammation, and neurotransmitters, are singly or additively associated with an increased risk of attention deficit-hyperactivity disorder (ADHD). We recruited 216 children diagnosed with ADHD and 216 age-, sex-, height-, weight-, and class-matched controls from 31 elementary schools in Taipei, Taiwan. The International Study of Asthma and Allergies in Childhood questionnaire was used to measure allergic symptoms. Fasting venous blood was collected and analyzed for complete blood count, white blood cell differential count, immunoglobulin (Ig) E level, and serotonin (5-HT) level. The results showed that symptoms of both rhinitis (OR = 2.08, 95% CI = 1.42-3.05) and eczema (OR = 1.72, 95% CI = 1.02-2.88) were significantly associated with increased risk of ADHD. Children with ADHD showed considerably lower levels of hemoglobin ( $p = 0.001$ ) and 5-HT ( $p < 0.001$ ) and higher IgE level ( $p < 0.001$ ) and eosinophil count ( $p = 0.001$ ) than did control children. ADHD risk increased with the number of aforementioned biochemical risk factors present (one factor: OR = 1.87, 95% CI = 0.87-4.18; two factors: OR = 2.90, 95% CI = 1.29-6.48; three factors: OR = 4.47, 95% CI = 1.97-10.13; four factors: OR = 6.53, 95% CI = 2.43-17.57). Findings suggest that either ADHD's etiology is multidimensional or the aforementioned conditions have shared etiology with ADHD.