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Attention-Deficit Hyperactivity Disorder (ADHD) as a Potential Predictor of Complementary Medicine Use among Adults: Findings from the 2007 National Health Interview Survey (NHIS)

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Behavioral Sciences and Health Education
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Abstract

Attention-Deficit Hyperactivity Disorder (ADHD) as a Potential Predictor of Complementary Medicine Use among Adults: Findings from the 2007 National Health Interview Survey (NHIS)

By Kirsten Bondalapati

Background: Attention-deficit hyperactivity disorder (ADHD) is a chronic mental disorder that affects 4.3%-4.7% of adults in the U.S. While first-line stimulant medication treatments have short-term benefits, long-term health outcomes are unclear and many adults do not adhere to stimulant medications over time. Complementary medicines, on the other hand, have been found to be used by adults with mental disorders more often than the general population. **Objectives:** The current study aims to measure national estimates of adult ADHD and their rates of specific, lifetime complementary medicine use. In addition, it aims to test ADHD as a predictor of complementary medicine use, adjusting for socio-demographic variables and depression, anxiety, and insomnia in the last 12 months. **Methods:** Data was analyzed from 2007 National Health Interview Survey (NHIS) dataset, including prevalence estimates of socio-demographics, mental illness, and complementary medicine use. A binary block regression model was employed in order to test the predictive affects of ADHD status on complementary medicine use. **Results:** Among the 2.9% of adults who reported lifetime ADHD, 68.7% reported any lifetime complementary medicine use. Adults with ADHD were significantly more likely to use any complementary medicine in their lifetime as well as 23 out of 36 specific complementary therapies, compared to adults without ADHD. ADHD was found to be a significant predictor of lifetime complementary medicine use, after adjusting for socio-demographic variables and depression, anxiety, and insomnia in the last 12 months; the odds of using complementary medicine was 1.68 times greater among adults with ADHD compared to adults without ADHD. **Conclusions:** Adults with ADHD were more likely to use complementary medicine in their lifetime compared to adults without ADHD. Adults with ADHD were significantly more likely to report co-morbid depression, anxiety, and insomnia compared to adults without ADHD. Lastly, ADHD was a significant predictor of complementary medicine use. Future research should replicate the current findings using clinical measures of mental illness and explore motivations for complementary medicine use among adults with ADHD in order to better determine treatment seeking behavior among the ADHD population.

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Introduction

Attention-deficit hyperactivity disorder (ADHD) is a chronic mental disorder that 8.1% of all U.S. adults will experience in their lifetime.[1] It is characterized by hyperactivity, impulsivity, inattention, or a combination of the three. Adult ADHD is associated with school dropout, unemployment, divorce, other mental disorders, and high annual medical costs.[2-4] Total cost of ADHD in the U.S. during 2000 was $31.6 billion.[5] Productivity and work loss due to adult ADHD is estimated to cost 120.8 million lost days of work and $19.6 billion salary-equivalent per year.[6]

Symptom manifestation varies across persons with ADHD, and commonly include mood swings, irritability, boredom, insecurity, loss of temper, social impairments, frequent job change, academic and occupational failure, and marital conflict.[7] ADHD is significantly associated with disability, specifically self-care, mobility, and cognitive issues. For example, persons with ADHD have reduced productivity and social role function compared to persons without ADHD.[2] Adults with ADHD score significantly lower on the Global Assessment of Functioning Scale, indicating poor psychosocial functioning among those with the disorder.[8] In regards to day-to-day activities, adults with ADHD frequently forget where they put things, forget work details, have difficulty in household affairs and child rearing, struggle to keep appointments, and have difficulty maintaining employment. In addition, unsafe driving behavior, poor financial decisions, and difficulty maintaining healthy relationships are common among adults with ADHD.[7]

Like many mental disorders, the underlying causes of ADHD are still unknown, making treatment an often elusive practice. Currently, treatment for ADHD in adulthood

is primarily stimulant medication; however, education and psychotherapy are widely used as well. Historically, stimulant medication for the treatment of ADHD in the U.S. began in the 1930s but did not gain FDA approval until 1961. The following decades saw an increase in stimulant use, as it became the first line treatment for the disorder.[9] More recently, the use of stimulant prescriptions for adult ADHD has increased from 61.7% in 1995 to 76.2% in 2002.[10] Research has shown that stimulant medications have many short-term benefits for persons with ADHD, such as inhibition of impulsivity, increased focus, and increased motivation.[11] While short-term benefits have been established, there is yet to be conclusive evidence on the potential long-term effects of stimulant medication as a treatment for ADHD. In addition, longitudinal studies show that many adults prescribed stimulant treatment for ADHD do not stay on their medications over time.[12] This suggests problems with stimulant use as a long-term treatment for ADHD. Whether the issue lies in adherence, cost, or effectiveness, stimulants do not seem to be a long-term solution for many people with ADHD.

In addition to conventional treatments, many people with mental disorders seek out complementary medicine therapies. According to the National Center for Complementary and Alternative Medicine (NCCAM), complementary medicine is defined as, “a group of diverse medical and health care systems, practices, and products that are not generally considered part of conventional medicine,” in which conventional medicine refers to Western or Allopathic medicine, as practiced by medical doctors (M.D.s), doctors of osteopathic medicines (D.O.s), and allied health professionals.[13] NCCAM groups complementary medicine into four broad categories: alternative medical systems (e.g. acupuncture, homeopathy), biological based therapies (e.g. chelation,

special diets), manipulative and body-based therapies (e.g. chiropractic manipulation, massage), and mind-body therapies (e.g. relaxation techniques, yoga). A complete description of all therapies can be found elsewhere.[14] Due to a lack of research in the effectiveness of complementary medicines, the potential interactions between conventional and complementary medicines are unknown, and potentially dangerous. Knowing which sub-populations are using particular complementary therapies may improve clinical practice as well as drive future research.

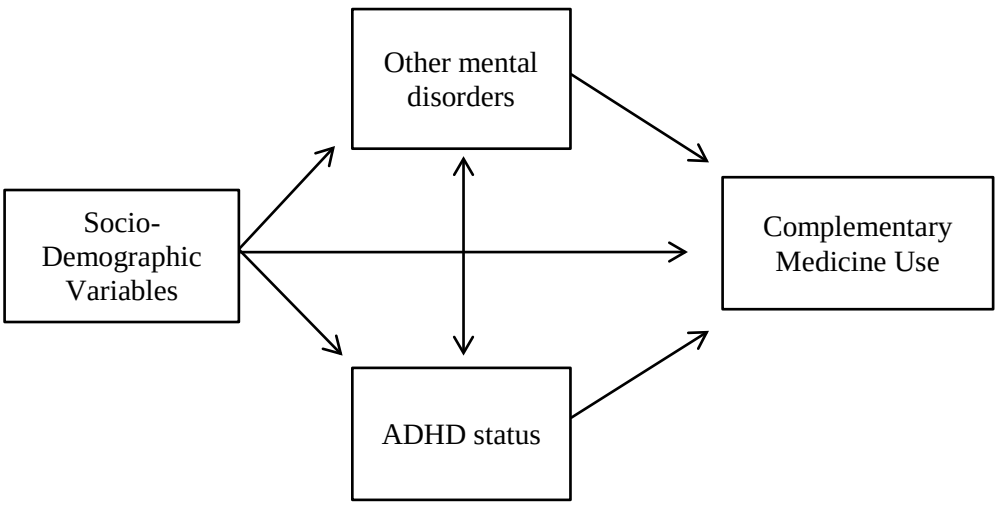
Research in the field of complementary medicine shows that adults with mental disorders are more likely to use complementary medicine compared to adults without mental illness and compared to adults in general.[15-17] This has been found across age groups and cultures.[18] While rates of complementary medicine use vary widely depending on the disorder, there is an evident association between mental illness and complementary medicine use.[19-21] The high rates of complementary medicine use among those with mental illness suggest inadequacies in the current convention treatment system.

The majority of this research focuses on depression and anxiety disorders as predictors of complementary medicine use. Complementary medicine use among people with ADHD is not often investigated, and when it is, it is often confined to child and adolescent populations. Furthermore, most existing literature on mental disorders and complementary medicine use does not consider the effect of other co-morbid, mental disorders on use of treatments. This is problematic, as ADHD is highly co-morbid with many mental disorders. It is estimated that 50%-70% of adults with ADHD have at least one comorbid mental disorder.[2] In order to examine the role of ADHD in complementary

medicine use, basic information about the relationship between ADHD, complementary medicine use, and other mental disorders is needed. **Figure 1** shows the purposed conceptual framework for the current investigation, in which complementary medicine use is the outcome variable, ADHD status is the primary independent variable, and other mental disorders (anxiety, depression, and insomnia) and socio-demographics are secondary independent variables.

The purpose of the current study is to examine the relationship between ADHD and complementary medicine use among a representative U.S. adult population. Specifically, the investigation will attempt to answer (1) what is the prevalence of complementary medicine use among U.S. adults with ADHD, (2) is ADHD status significantly associated with complementary medicine use, and (3) is ADHD a predictor of complementary medicine use, controlling for socio-demographic variables and other mental illness (specifically depression, anxiety, and insomnia). Results will provide information about treatment behaviors among adults with ADHD, including which specific complementary therapies are used among this population. In addition, results may inform research on complementary medicine among adults with mental disorders, illuminating the potential need to incorporate ADHD in future studies.

Figure 1. Conceptual model for ADHD and complementary medicine use, with socio-demographic variables and other mental illness as covariates



Literature Review

ADHD has historically been more commonly diagnosed among children compared to adults. In order to understand why this may be, it is useful to consider prevailing definitions of ADHD. ADHD is defined by the National Institute of Mental Health (NIMH) as a childhood disorder that may persist into adulthood.[22] The current Diagnostic Statistical Manual for Mental Disorders (DSM-IV) requires the presence of ADHD symptoms before the age of 7 for diagnostic criteria.[23] In a review article on the age of onset of various mental disorders, the average age of onset reported for ADHD is 7-9 years old.[24] As of 2007, an estimated 9.5% of U.S. children meet the DSM-IV criteria for ADHD.[25]

In spite of the focus on child and adolescent ADHD, a 2002 review of ADHD persistence concluded that between 30-66% of children diagnosed with ADHD continue to show clinical diagnosis adulthood.[7] While the range is large, persistence may be underestimated due to losing patients as they transition from child to adult health care settings during young adulthood. Data from the National Ambulatory Medical Care Survey (NAMCS), an annual representative survey of U.S. office-based physician practices, showed a significant increase in the diagnosis of ADHD among adults, doubling from 1995 to 2002.[10] Current prevalence of adult ADHD within a given 12 month period is estimated to be between 4.3%-4.7%.[1, 2] These numbers have been increasing in the past decade. One study of insured, employed U.S. adults found that prevalence of ADHD increased from 1.24 cases per 1000 adults in 2002 to 4.02 cases in 2007. Prevalence was highest among 18 to 24 year olds, of which 42.8% to 45.8% had

significant symptoms of ADHD, as defined by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).[26] While this study is limited in that it does not include adults who are unemployed, a characteristic commonly associated with ADHD, it does show that treatment for ADHD has been increasing in recent years.

Other socio-demographic variables are significantly related to both ADHD and complementary medicine use. In regards to gender, males have historically been diagnosed with ADHD more often compared to females, but this is thought to be a product of clinical under-recognition and differences in symptom manifestation.[27] The gender gap has been closing in recent years, as multiple studies have reported nearly equal rates of ADHD in men and women.[10, 26, 28] Several studies have found adults with ADHD to be at higher odds of being unemployed and previously married compared to adults without ADHD.[2, 3] Data from the 1996 Medical Expenditure Panel Survey found that predictors of complementary medicine included being female, non-Hispanic White, having high educational attainment, and living in the West or Midwest.[29] NHIS results from the 2002 and 2007 surveys show that non-Hispanic Whites and American Indian or Alaska Natives were more likely to use complementary medicine compared to Asians and Blacks/African Americans.[14, 30]

There is an abundance of literature demonstrating the comorbid nature of many mental disorders.[31, 32] Adults diagnosed with ADHD have been found to be significantly more likely to have many other common mental disorders compared to adults without ADHD. Results from the National Comorbidity Study Replication (NCS-R) found that adults with ADHD were more likely to have major depressive disorder, dysthymia,

bipolar disorder, generalized anxiety disorder, PTSD, panic disorder, agoraphobia, specific phobia, social phobia, drug dependence and intermittent explosive disorder compared to adults without ADHD.[2] In a family study of parents with and without ADHD, those with ADHD were significantly more likely than those without ADHD to have major depression, two or more anxiety disorders, oppositional defiant disorder, and substance use disorders.[33] A clinical comparison study found that adults with ADHD were significantly more likely to have oppositional defiant disorder, conduct disorder, antisocial personality disorder, major depressive disorder, alcohol abuse, drug abuse, drug dependence, anxiety disorder, agoraphobia, social phobia, and speech disorders compared to adults without ADHD.[8] In a case-control study using claims data, adults with ADHD were more likely to have anxiety, bipolar disorder, depression, drug or alcohol abuse, antisocial disorder, or oppositional disorder compared to adult without an ADHD diagnosis.[34] Taking the above literature into account, while comorbidity is diverse, depressive and anxiety disorders are the most commonly comorbid disorders with adult ADHD. Much treatment research among persons with mental illness does not include ADHD in the measurement of the study, meaning the effects of ADHD as a comorbid disorder are not accounted for in such research.

Even with the availability of conventional treatments for mental disorders, the use of complementary medicine remains higher among persons with mental disorders compared to those without. A nationally representative survey of the U.S. population found that 21.3% of complementary medicine users met diagnostic criteria for one or more mental disorders, while only 16.5% of non-complementary medicine users met diagnostic criteria. Specifically, those who used complementary medicine were more

likely to have major depressive disorder, panic disorder, generalized anxiety disorder, or mania or psychosis.[16] An analysis of the 2002 National Health Interview Survey (NHIS) found that about 1.6 million adults use complementary medicine therapies to treat insomnia or trouble sleeping.[35] A national survey of Australian adults found that having a mental health condition was the strongest predictor of complementary medicine use, greater than frequency of physician visits, socio-demographic characteristics, being a current smoker, diet, exercise, alcohol intake, insurance type, and a variety of chronic physical illnesses.[36] Data from the National Survey of American Life (NSAL) and the National Comorbidity Survey Replication (NCS-R) show that, in a sample of persons with diagnosed mood, anxiety, or substance use disorders, 34% reported using complementary medicine in the past 12 months.[20] In addition, a study of Finnish adults found participants with comorbid depression and anxiety were the most likely to use complementary medicine, compared to those with depression, anxiety, or alcohol use disorders (AUD) alone, suggesting a potential dose-response relationship between number of mental disorders and complementary medicine use.[19] A cross-country European study found that adults with mood or anxiety disorders were significantly more likely to see a complementary medicine practitioner compared to those without these disorders, and adults with AUD were significantly less likely than those without AUD.[37] The above literature illuminates the comorbidity of adult ADHD and depressive, anxiety, and substance use as well as the link between complementary medicine and depressive and anxiety disorders. While ADHD is comorbid with substance use disorder, the link between complementary medicine and substance use disorders is mixed at best, thus

focusing on the relationship between adult ADHD, depression, anxiety, and complementary medicine is advised.

There are limited published studies regarding mental health and complementary medicine studies that include ADHD in their measurement of mental disorders. The few studies that do address ADHD within the context of complementary medicine use are among child or adolescent populations.[38-40] High comorbidity levels of ADHD with other mental disorders and the strong association between mental disorders and complementary medicine suggests that ADHD may play a role in complementary medicine use behavior among adult, and potentially more so among adults with other mental disorders. The current study aims to investigate ADHD as a potential contributor to complementary medicine use among a representative sample of U.S. adults.

Methods

Data & Sampling

The current study is a secondary analysis of data from the 2007 National Health Interview Survey (NHIS).[41] The NHIS is a representative, population-based survey of the non-institutionalized, civilian U.S. population. The NHIS is a cross-sectional study conducted annually by the National Center for Health Statistics (NCHS) through the Center for Disease Control and Prevention (CDC). It has been in existence since 1957. The most recent survey reconstruction occurred in 1995 in order to account for growing minority populations and allow for sampling by state. In addition, sampling design changes occurred after the 2005 survey in order to reduce the sample size as a consequence of budget cuts. Data are collected for the NHIS through computer-assisted

personal interviewing (CAPI) conducted by U.S. Census Bureau staff. All data are self-report.

Sampling for the NHIS employs a multi-stage, cluster probability design. Counties or groups of counties are used as sampling units, in which houses are randomly selected and families are interviewed. The NHIS contains three core components: the Family Core, Sample Adult Core and Sample Child Core. All adults within a household are invited to participate in the Family Core. For the Sample Adult Core, one adult is randomly selected to provide additional information, and for the Sample Child Core, one parent or guardian is randomly selected as a proxy to provide additional information for a child within the household. For the Sample Adult Core, oversampling of African Americans, Asians, and Hispanics and persons aged 65 years or older ensured more accurate estimates for minority populations. Sampling weights allow for a representative estimation of parameters of the non-institutionalized U.S. population. In the 2007 NHIS, those who completed the Sample Adult Core also completed the Alternative Health Supplement. This supplement collects information about complementary medicine use and has been included in the 2002, 2007 and 2012 NHIS. Data from the 2012 NHIS are not publically available until June 2013; thus, data from 2007 are used in the current study, as they are the most recently available data from the NHIS that include the Alternative Health Supplement.

The 2007 NHIS Sample Adult contains 23,393 individuals (age $\geq$ 18 year), with an overall sample adult response rate of 67.8%. The total sample includes 22,783 individuals who answered at least one question on the Alternative Health Supplement. A

more detailed description of the design, sampling, collection, and de-identification procedures can be found elsewhere.[42, 43]

An exemption from the Institution Review Board (IRB) was obtained through an Emory University IRB staff person, as data are considered non-Human Subject Research (non-HSR) due to them being a publically available and de-identified.

Measures

The NHIS covers a wide variety of health topics such as health behaviors, health status, health care access and utilization, and socio-demographic characteristics. The current analysis deals with topic specific socio-demographic variables, complementary medicine therapies, lifetime ADHD status, and depression, anxiety, and insomnia in the last 12 months. Insomnia was chosen, in addition to depression and anxiety, because it is one of the only other mental illness variables included in the 2007 NHIS and it has been found to be comorbid with both anxiety and depression.[35]

Socio-demographics. Socio-demographic characteristics examined are age, sex, race, marital status, education level, and employment status. Age was measured continuously, with respondents filling in their age in years. Sex was divided into female and male. Race was measured with five categories, White non-Hispanic, Black / African American only, American Indian or Alaskan Native only (AIAN), Asian only, or Multiple Race. Categories for marital status included married or living together (including "Married – spouse in household," "Married – spouse not in household," "Married – spouse in household, unknown," and "Living with partner"), previously married (including "Widowed," "Divorced," and "Separated"), and never married. Those who indicated "Unknown marital status" were coded as missing. For educational

attainment, respondents were categorized into ≤ high school/GED (including "Less/equal to 8th grade," "9-12th grade, no high school diploma," and "High school graduate/GED recipient"), some college or Associates of Arts (AA) degree (including "Some college, no degree," "AA degree, technical or vocational," and "AA degree, academic program"), and Bachelor's or higher degree (including "Bachelor's degree" and "Master's, professional, or doctoral degree"). Employment status was categorized as either employed (including "Working for pay at a job or business," "With a job or business but not at work," and "Working, but not for pay, at a family-owned job or business") or unemployed (including "Looking for work" or "Not working at a job or business and not looking for work"), measured as employment as of last week. For martial education attainment and employment status, those who reported "Refused," "Not ascertained," or "Don't know" were coded as missing.

Complementary Therapies. The 2007 Alternative Health Supplement contains questions on 39 different complementary therapies (e.g. chiropractic manipulation, Ayurveda medicine, relaxation techniques, biofeedback, and special diets). Therapies are categorized into four broad groups, indicating the type of complementary medicine. These groups are alternative medicine systems, biologically-based therapies, manipulative and body-based therapies, and mind-body therapies. Alternative medicine systems include acupuncture, Ayurveda, homeopathy, naturopathy, and traditional healers (traditional healers includes botanic, curandero, espiritista, Native American healer/medicine man, shaman, sobador, and hierbero or yerbera). Biologically-based therapies include chelation, non-vitamin/non-mineral dietary supplements (NV/NMDS), and special diets (special diets includes Atkins, macrobiotic, Ornish, Pritikin, South

Beach, Vegetarian, and Zone). Manipulative and body-based therapies include chiropractic or osteopathic manipulation, massage, and movement techniques (movement techniques include Alexander technique, Feldenkreis, Pilates, and Trager integration). Finally, mind-body therapies include biofeedback, relaxation techniques (relaxation techniques include deep breathing exercises, guided imagery, meditation, progressive relaxation, stress management class, and support group meetings), prayer for health, hypnosis, yoga, tai chi, qi gong, and energy healing. A complete description of each therapy can be found elsewhere.[14] On the 2007 NHIS Alternative Health supplement, prayer for health reasons was also measured as a complementary therapy; however, it is no longer widely recognized as a form of complementary medicine. Previous studies have shown that the inclusion or exclusion of prayer for health reasons makes a fundamental difference in complementary medicine disparities, specifically racial and ethnic differences. If prayer is included as a complementary therapy, it is typically the most common, with rates far above any other therapy. One nationally representative study found that prevalence of complementary medicine doubled when including prayer for health reasons.[44] Separating prayer from other complementary therapies allows a more focused look at complementary medicine and allows comparability across studies. Prayer has been excluded from many previous complementary medicine studies, and is also excluded for the current study, resulting in 38 total therapies.[44, 45] For each therapy, respondents were asked whether or not they had ever used it in their lifetime.

Mental Illness. ADHD status was measured by asking, “Have you ever been told by a doctor or other health professional that you had attention deficit disorder / hyperactivity?” Regarding other mental illness, depression was measured as “During the

past 12 months, have you been frequently depressed?" anxiety as, "During the past 12 months, have you been frequency anxious?" and insomnia as, "During the past 12 months, have you regularly had trouble sleeping or insomnia?" All mental illness variables had dichotomous responses choices of "Yes" or "No."

Analysis

Weighted frequencies (N) and percentages (%) and standard errors (SE) or means (M) and standard deviations (SD) are reported for socio-demographic variables among the total sample, across ADHD status and across those who reported never using complementary medicine and those who have ever used it in their lifetime. Rao-Scott chi-square tests and p-values are reported for comparisons of socio-demographic variables across persons with and without ADHD as well as across person who have ever used complementary medicine and those who have never used complementary medicine in their lifetime (**Table 1**). Prevalence of any complementary medicine use and prevalence of specific complementary therapies are reported across ADHD status in order to identify prominent therapies associated with ADHD. Rao-Scott chi-square tests and p-values are reported for comparisons of complementary therapies across ADHD status (**Table 2**).

A block multivariate binary regression model was run in order to determine the predictive value of ADHD status in complementary medicine use (**Table 3**). A block regression was chosen, as it allows for examination of the focal relationship, ADHD and complementary medicine use, alone and the examination of this relationship in the context of relevant socio-demographic variables, and other mental illnesses. The first block, Model A, tests the focal relationship only; i.e. how the presence of adult ADHD affects may affect complementary medicine use. Socio-demographic variables that were

found to have a significant bivariate association with complementary medicine use were added for the second block, Model B, in order to test their influence on the ADHD predictive model. The third block, Model C, added other mental illness variables, including depression, anxiety, and insomnia, in order to test the influence of other mental illness on the ADHD predictive model. Odds ratios, 95% confidence intervals, and p-values of Wald chi-square tests are reported.

To account for the complex survey design of the NHIS, SAS-Callable SUDDAN Statistical software was used for all analyses. Estimates were calculated using sampling strata, primary sampling units, and the Sample Adult Weight to produce representative estimates according to 2000 U.S. Census statistics. Due to weighting and clustering of sample design, all parameters were estimated using the Taylor series linearization method.[46] Statistical significance was evaluated using an alpha level of 0.05.

Results

Descriptive Statistics

The total adult population included 218,441,299 participants (**Table 1**), of which the average age was 45.8 years (SD=0.19) and 51.7% (SE=0.44) were female. The majority of the population (81.1%, SE=0.41) reported identifying as White, while 11.7% (SE=0.34) identified as Black/African American, 4.6% (SE=0.18) as Asian, 1.3% (SE=0.10) as Multi-racial, and 1.0% (SE=0.17) as American Indian/Alaskan Native. A little over sixty percent (62.7%, SE=0.49) of the population reported being married or living together with their partner, while 20.3% (SE=0.47) reported being never married and 17.0% (SE=0.28) reported being previously married. Educational attainment was

more equally distributed across the population, with 36.1% (SE=0.55) receiving a Bachelor's, Master's, Professional, or Doctoral degree, 32.3% (SE=0.51) receiving a high school degree or GED or less, and 31.7% (SE=0.47) receiving some college or a two year AA degree. A little over a third (35.3%, SE=0.48) of the total population reported being unemployed during the last week. For mental illness, 2.9% (SE=0.15) reported lifetime ADHD, 10.8% (SE=0.25) reported being frequently depressed in the last 12 months, 10.8% (SE=0.28) reported being frequently anxious in the last 12 months, and 18.1% (SE=0.32) reported having insomnia or trouble sleeping in the last 12 months. Lifetime complementary medicine use was reported among 54.4% (SE=0.56) of the entire population (**Table 2**).

Bivariate Analyses

Results from an independent t-test and Rao-Scott chi-square tests suggest significant differences in all but one socio-demographic characteristic among adults who have ADHD compared to those who do not have ADHD (**Table 1**). Adults with ADHD were significantly more likely to be younger, male, and White, AIAN, or Multiracial, and less likely to be married or living with a partner or highly educated. Employment status was the only socio-demographic variable that did not show a significant difference across ADHD status. In regards to other mental illness, adults with ADHD were significantly more likely to report depression, anxiety, and insomnia in the past 12 months compared to adults without ADHD. The data show significant differences in all socio-demographic and other mental illness variables when comparing adults who ever used complementary medicine with adults who have never used complementary medicine in their lifetime (**Table 1**).

In addition to socio-demographic variables, adults with ADHD were significantly more likely to have used any complementary medicine in their lifetime. Among adults with ADHD, 68.7% (SE=2.68) reported lifetime complementary medicine use, which is significantly higher than the 54.0% (SE=0.57) of adults without ADHD (X^2=24.80, p<.0001). In addition, adults with ADHD were significantly more likely to use 23 specific therapies, out of 36 total therapies, compared to adults without ADHD (**Table 2**). Looking at specific therapies, compared to adults without ADHD, those with ADHD were more likely to report ever using homeopathy, botanica, Native American healer / medicine man, Hierbero or Yerbera, non-vitamin / non-dietary mineral supplements (NVNDMS), any special diet, macrobiotic diet, vegetarian diet, zone diet, chiropractic or osteopathic manipulation, massage, any relaxation technique, deep breathing exercises, guided imagery, meditation, progressive relaxation, stress management class, support group meeting, hypnosis, yoga, tai chi, and qi gong. The remaining 19 therapies were not statistically associated with ADHD status.

Multivariate Binary Logistic Regression

Table 3 shows the results of all three binary logistic regression models. Results from Model A show that for adults with ADHD, the odds of ever using complementary medicine was higher by a factor of 1.86 (95% CI:1.45, 2.39, p<.0001) compared to those without ADHD.

Results from Model B indicate that ADHD status and all socio-demographic variables, expect for marital status, were found to be significant predictors of complementary medicine use. Results indicated that being older, female, White, AIAN, multiple race, of higher educational attainment, and employed were all associated with a

greater likelihood of lifetime complementary medicine use. Identifying as Black or African American or Asian, compared to identifying as White, was associated with decreased odds of lifetime complementary medicine use. In addition, compared to having a Bachelor's or higher degree, having an education of ≤ high school/GED or some college/AA degree was predictive of lower odds of complementary medicine use. After adjusting for socio-demographic variables in Model B, ADHD remained a significant predictor of lifetime complementary use, with the odds of using complementary medicine being higher by a factor of 2.15 (95% CI: 0.652, 0.743, p<.0001) among adults with ADHD compared to those without ADHD.

When including ADHD status, socio-demographic variables, and other mental illness as predictors (Model C), ADHD, age, sex, ethnicity, educational attainment, employment status, depression, anxiety, and insomnia were significant predictors of lifetime complementary medicine use. In regards to mental illness, insomnia was the strongest predictor of complementary medicine use (OD=2.13, [95% CI: 1.913, 2.359], p<.0001), followed by anxiety (OR=1.90, [95% CI: 1.658, 2.175], p<.0001), then depression (OR=1.23, [95% CI: 1.073, 1.405], p=0.0029). Adjusting for all socio-demographic and other mental illness variables, ADHD remained a significant predictor of complementary medicine use, of which the odds of using complementary medicine were higher among adults with ADHD by a factor of 1.68 (95% CI: 1.282, 2.188, p=0.0002).

Discussion

Findings

In summary, in 2007, an estimated 2.9% of U.S adults reported ever having ADHD, of which 68.7% reported lifetime use of any complementary medicine. Adult ADHD was significantly associated with any lifetime complementary medicine use as well as the use of 23 specific therapies. Adult ADHD was also a significant predictor of complementary medicine, when adjusted for a variety of socio-demographic variables and other mental illnesses. Specifically, ADHD was a strong predictor of lifetime complementary medicine use, even when adjusting for age, sex, ethnicity, educational attainment, employment status, and recent depression, anxiety, and insomnia.

This analysis of the 2007 NHIS data both confirmed earlier findings and added to the ADHD and complementary medicine literature. The 2.9% prevalence of lifetime ADHD among adults is slightly lower than current U.S. estimates, which range from 4.2% to 8.1% within the U.S., with most studies reporting within the 4% to 5% range.[1, 2, 47, 48] This range is thought to reflect various methodological differences between studies.[49]

The current study reports the first estimate of lifetime complementary medicine use among adults with ADHD, providing evidence that adults with ADHD are in fact seeking complementary medicines, and significantly more are doing so than adults without ADHD. This finding mirrors previous findings that children with ADHD are more likely to use complementary medicine than children without ADHD.[38-40]

Compared to adults without ADHD, those with ADHD were significantly more likely to have used 23 specific complementary therapies in their lifetime. Many of these fell under biologically based therapies, including some special diets and supplement use. Mind-body techniques represented the greatest number of significant therapies, including

all six relaxation techniques measured as well as hypnosis, yoga, tai chi, qi gong, and energy healing. Future research should explore these therapies more closely. Understanding why mind-body therapies are an attractive option for adults with ADHD may help clinicians better understand treatment needs. In addition, it could help unveil conceptualizations of ADHD; for example, some adults with ADHD might see the condition as a mind or brain disorder that is less likely to be treated through external bodily manipulation or alternative health systems compared to mind-body approaches. Some mind-body therapies rank the most common among the overall U.S. population, including deep breathing, yoga, and meditation. However, the other mind-body therapies that were found to be prevalence among adults with ADHD do not rank as high among the general U.S. adult population, in which therapies such as chiropractic or osteopathic manipulation and non-mineral / non-vitamin dietary supplements remain the most common.[14] In addition to mind-body, other significant therapies were homeopathy, Native American healer / medicine man, Hierbero or Yerbero, chiropractic or osteopathic manipulation, and massage. The variety of complementary therapies used by adults with ADHD may indicate a demand for additional or unmet treatment needs. Other factors may be at play, such as lack of knowledge regarding which complementary therapies may be appropriate for ADHD treatment. Another factor may be the existence of a wide variety of motivations for seeking complementary therapies. Considering the high rates of comorbidity between ADHD and other mental disorders, it is also possible that adults with ADHD are seeking complementary medicine in order to treat other conditions rather than their ADHD.

Adult ADHD was a significant predictor of lifetime complementary medicine use, both unadjusted and adjusted for socio-demographics and other mental illnesses. This adds to the literature of ADHD and complementary medicine, as no previous studies have examined this relationship. While there are no comparative studies for adults with ADHD, the current findings align with previous research that adults with mental disorders are more likely to use complementary medicine.[15, 50, 51] Of particular interest are two studies that found self-reported anxiety and depression to be significantly associated with greater complementary medicine use among adults.[17, 52] In addition, one study found that among U.S. adults with insomnia or trouble sleeping, 4.5% used a form of complementary medicine to treat this condition.[35] Another study found that adults with mental illness were at 1.27 times higher odds of using complementary medicine compared to those without mental illness.[53] The significance of adult ADHD in predicting complementary medicine use is illuminating, suggesting that ADHD is an important comorbidity to consider within mental health research and a significant, independent factor that influences lifetime complementary medicine use.

The current study found that adult ADHD is significantly associated with recent depression, anxiety, and insomnia or trouble sleeping, confirming well-established comorbidity research. In addition to ADHD, the other mental illnesses were found to be significant predictors of complementary medicine. The varying strength of the odds ratios for ADHD, depression, anxiety, and insomnia supports a previous population-level study that found complementary medicine use varies according to mental disorder.[19]

Limitations

The current study was not without limitations. First, the study excludes homeless and institutionalized populations. This is specific concern for the current study as these populations represent two vulnerable groups in regards to mental illness. Second, all measures were self-report. Estimates relied on respondent memory and accurate interpretation of each survey question.

Third, the measures of mental illness included in this study may have lacked precision and comparability. For example, estimates of depression were based on self-report of, "been frequently depressed," in the last 12 months. This not only lacks any standardized diagnostic criteria, but it includes a vague frame for occurrence, potentially interpreted differently across individuals. It also limits depression to the past year of life. Depression takes many forms, has varying levels of severity, and is a disorder often remits and returns. Similar criticisms can be said of the anxiety and the insomnia measures. The depression, anxiety, and insomnia measures may not be directly comparable to ADHD status, as the ADHD measure asks for lifetime experience of ADHD, as told by a health professional. I argue that this comparability is actually not a limitation, as ADHD is a lifetime disorder that begins, for the overwhelming majority, during childhood or adolescence, unlike that of depression, anxiety or insomnia.[1] The self-report nature of the mental illness measures may also cause comparison difficulties to other research, especially those using DSM-IV or ICD-10 clinical measures. Without a clinical assessment, true diagnosis and severity of illness cannot be known.

Fourth, substance abuse was not included in the other mental illnesses tested in final the multivariate model. Substance use has been found to be comorbid with ADHD, thus provides some incentive to include in the current analysis. Initial exclusion was

based on the vagueness of the item in the 2007 NHIS, which reads, “During the past 12 months, have you had substance abuse, other than alcohol or tobacco?” Final decision to exclude was based on research that substance abuse has been found to be a non-significant predictor of complementary medicines use.[15, 20, 53] Future studies may want to explore the interaction effect of ADHD and substance abuse on health service use.

Fifth, only lifetime, as opposed to current, complementary medicine was considered in the current study. Much previous research on complementary medicine includes 12 month prevalence estimates, making comparisons between the current study and previous research potentially difficult. In addition, 12 month prevalence of complementary medicine use may be a better outcome variable when working with mental illness variables that specify experiencing the illness in the last 12 months. While this may be limiting, lifetime complementary medicine is useful in the context of ADHD, which is a lifetime mental disorder that begins early in life. In addition, examining lifetime use allows for a more comprehensive picture of complementary medicine in the U.S. Lifetime use may potentially detect specific therapies that have low 12-month prevalence and would not show up statistically in a 12-month analysis. For example, some traditional healer therapies, such as botanica and shaman, do not have high enough 12-month frequencies to report among a national sample, but they when examining frequency of lifetime use.[14] Future studies involving adult ADHD and complementary medicine use should consider the pros and cons of lifetime verses 12-month complementary medicine use in order to employ more precise and comparable measures.

Implications and Future Research

Even with these limitations, the current study utilized a national, representative sampling frame that allows for generalization of results to the U.S. adult population. This allows reliable conclusions about the prevalence of adult ADHD and complementary medicine use. In addition, this exploratory analysis provides a starting point for future research regarding adult ADHD and complementary medicine use, and adds to literature on mental health and health service use overall.

Current findings suggest that ADHD is an important condition when considering health services use among U.S. adults. Complementary medicine practitioners should be aware that many of their patients may have ADHD and other mental illnesses, and conventional clinicians should be aware that conditions such as ADHD may be driving their treatment seeking behavior outside the conventional setting. Conventional providers, specifically mental health practitioners, who are treating adults with ADHD, should inquire about their patients' use of complementary therapies. Collaboration across treatment settings would be ideal in order to best plan a treatment program for adults with ADHD. This may improve overall health care for adults with ADHD and prevent potential harmful interactions between conventional and complementary medicine.

Future research should explore the relationship between complementary medicine use, adult ADHD, and other mental disorders. We have concluded that adult ADHD is a significantly predictor of lifetime complementary use (even in the context of other significant covariates). Left unknown is the predictive effect of adult ADHD on specific complementary therapies and the interaction effects of adult ADHD and other mental disorders on complementary medicine use. In addition, much remains to be known regarding the effectiveness of complementary medicine use as a form of treatment and

motivations for seeking complementary medicine use among adults with ADHD. Continuous surveillance of complementary medicine use among adults with ADHD will help track rates of adult ADHD as well as changes in types of complementary medicine used by this population. Such research will help in understanding treatment behavior among adults with ADHD, hopefully illuminating weaknesses in current treatments and lead to improved patient well-being through coordination and collaboration across treatment settings.

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Table 1. Socio-demographic differences among total population, those with or without ADHD, and those ever or never used complementary medicine in their lifetime

Variable	Total adult population N=218,441			ADHD ever N=6,288			No ADHD ever N=211,848			X^2	Ever used Complementary Medicine N=118,834			Never used Complementary Medicine N=99,607			X^2
	N	%/M	SE/SD	N	%/M	SE/SD	N	%/M	SE/SD		N	%/M	SE/SD	N	%/M	SE/SD	
Age (M/SD)	218,441	45.8	.19	6,288	34.3	.70	211,848	46.1	.20	16.35*	118,834	46.6	0.23	99,607	44.78	0.26	5.96*
Gender																	
Female	113,024	51.7	0.44	2,257	35.9	2.52	110,623	52.2	0.44	37.89*	65,298	54.9	0.57	47,727	47.9	0.58	88.89*
Male	105,417	48.3	0.44	4,031	64.1	2.52	101,225	47.8	0.44		53,536	45.1	0.57	51,991	52.1	0.58	
Ethnicity																	
White	177,213	81.1	0.41	5,557	88.7	1.59	171,438	81.0	0.41		100,104	84.3	0.48	77,109	77.5	0.59	
Black/AA	25,661	11.7	0.34	349	5.6	0.97	25,259	11.9	0.36	22.65*	10,042	8.5	0.35	15,619	15.7	0.51	169.84*
AIAN	2,172	1.0	0.17	94	1.5	0.83	2,065	1.0	0.17		1,298	1.1	0.18	874	0.9	0.19	
Asian	191,499	4.6	0.18	1,378	2.2	0.78	9,988	4.7	0.18		5,482	4.6	0.25	4,658	4.7	0.31	
Multiple race	2,934	1.3	0.10	130	2.1	0.51	2,796	1.3	0.10		1,762	1.5	0.13	1,173	1.2	0.14	
Marital status																	
Married/living together	136,423	62.7	0.49	2,926	46.7	2.70	133,409	63.2	0.49	129.6*	76,397	64.4	0.6	60,026	60.5	0.7	36.52*
Prev. married	37,039	17.0	0.28	697	11.1	1.29	36,229	17.2	0.29		20,246	17.1	0.38	16,793	16.9	0.41	
Never married	44,243	20.3	0.47	2,644	42.2	2.64	41,520	19.7	0.47		21,912	18.5	0.55	22,331	22.5	0.65	
Education																	
≤ High school	69,998	32.3	0.51	1,686	26.8	2.32	68,187	32.4	0.51		28,666	24.2	0.57	41,332	42.0	0.68	
Some college	68,685	31.7	0.47	2,647	42.1	2.65	65,985	31.4	0.47	17.73*	38,663	32.6	0.59	30,023	30.5	0.64	572.92*
Bachelors or higher degree	1,749	36.1	0.55	1,955	31.1	2.74	76,224	36.2	0.55		51,310	43.2	0.7	26,941	27.4	0.69	
Employment status																	
Employed	141,027	64.7	0.48	3,818	60.9	2.61	137,092	64.8	0.48	2.46	78,983	66.5	0.57	62,044	62.5	0.67	26.34*
Unemployed	77,050	35.3	0.48	2,455	39.1	2.61	74,406	35.2	0.48		39,829	33.5	0.57	37,221	37.5	0.67	
Mental Illness																	
ADHD	6,288	2.9	0.15	-	-	-	-	-	-	-	4,316	3.6	0.21	1,971	2.0	0.22	24.80*
Depression	23,473	10.8	0.25	1,877	29.9	2.40	21,545	10.2	0.25	138.21*	15,935	13.4	0.36	7,538	7.6	0.34	122.60*
Anxiety	23,575	10.8	0.28	2,156	34.4	2.47	21,367	10.1	0.27	220.15*	17,281	14.6	0.42	6,295	6.34	0.29	274.60*
Insomnia	39,528	18.1	0.32	2,248	35.9	2.73	21,545	10.2	0.25	71.57*	28,286	23.8	0.49	11,242	11.3	0.40	357.35*

*p<.05

Table 2. Lifetime complementary medicine use among total population and those with or without ADHD

	Total adult population N=218,441			ADHD ever N=6,288			No ADHD ever N=211,848			X^2
Variable	N	%	SE	N	%	SE	N	%	SE	
Any complementary medicine	118834	54.4	0.56	4,316	68.7	2.68	114,436	54.0	0.57	24.80*
Alternative medical systems										
Acupuncture	14009	6.4	0.23	501	8.0	1.38	13,492	6.4	0.23	1.50
Ayurveda	1307	0.6	0.07	69	1.1	0.76	1,238	0.6	0.07	0.81
Homeopathy	8096	3.7	0.16	566	9.01	1.48	7,510	3.6	0.16	28.77*
Naturopathy	3390	1.6	0.11	105	1.7	0.66	3,285	1.6	0.11	0.03
Traditional Healers	4919	2.3	0.16	203	3.2	1.12	4,697	2.2	0.16	1.17
Botanica	345	0.2	0.03	44	0.7	0.44	288	0.1	0.03	7.25*
Curandero	97	0.3	0.04	10	0.2	0.17	641	0.3	0.05	0.40
Espiritista	1547	0.7	0.10	61	1.0	0.63	146	0.7	0.1	0.23
Native Amer. medicine man	177	0.4	0.08	86	1.4	0.82	700	0.3	0.08	5.82*
Shaman	649	0.3	0.05	36	0.6	0.3	613	0.3	0.05	1.64
Sobador	785	0.4	0.04	-	-	-	785	0.4	0.04	-
Hierbero or Yerbera	667	0.3	0.05	3	0.0	0.04	664	0.3	0.05	5.23*
Biologically-based therapies										
Chelation	787	0.4	0.05	27	0.4	0.25	760	0.4	0.05	0.09
NV/NMDS[§]	55090	25.4	0.45	2,136	34.0	2.49	52,927	25.2	0.45	14.86*
Special diets	19063	8.7	0.25	815	13.0	1.78	18,236	8.6	0.26	8.27*
Atkins	9518	4.4	0.16	301	4.8	1.04	9,210	4.4	0.16	0.17
Macrobiotic	623	0.3	0.04	48	0.8	0.34	575	0.3	0.04	5.09*
Ornish	245	0.1	0.03	17	0.3	0.19	229	0.1	0.03	1.51
Pritikin	401	0.2	0.04	29	0.5	0.25	372	0.2	0.04	3.23
South Beach	5114	2.4	0.14	156	2.5	0.89	4,958	2.4	0.14	0.02
Vegetarian	6839	3.2	0.14	381	6.1	1.27	6,452	3.1	0.14	10.15*
Zone	1030	0.5	0.06	76	1.2	0.54	954	0.5	0.06	4.68*
Manipulative and body-based therapies										
Chiropractic or osteopathic manipulation	51299	23.6	0.48	1,856	29.5	2.56	49,417	23.4	0.48	6.79*
Massage	36569	16.8	0.37	1,615	25.7	2.3	34,931	16.6	0.37	20.87*

Movement techniques	7516	3.4	0.16	251	4.0	0.85	7,265	3.4	0.16	0.48
Alexander technique	543	0.3	0.04	13	0.2	0.15	530	0.3	0.04	0.06
Feldenkreis	525	0.2	0.04	36	0.6	0.38	490	0.2	0.04	1.81
Pilates	6868	3.2	0.15	193	3.1	0.76	6,675	3.2	0.16	0.02
Trager integration	317	0.2	0.03	32	0.5	0.4	285	0.1	0.03	2.88
Mind-body therapies										
Biofeedback	3214	1.5	0.13	153	2.4	0.86	3,061	1.5	0.13	2.01
Relaxation techniques	44939	20.6	0.40	2,145	34.1	2.38	42,741	20.2	0.40	44.958
Deep breathing exercises	33274	15.4	0.33	1,581	25.3	2.18	31,663	15.1	0.33	30.60*
Guided imagery	7794	3.6	0.19	514	8.2	1.29	7,267	3.5	0.19	26.66*
Meditation	26466	12.2	0.32	1,389	22.1	2.00	25,047	11.9	0.32	38.76*
Progressive relaxation	9294	4.3	0.19	614	9.8	1.35	8,681	4.1	0.20	34.01*
Stress management class	4851	2.2	0.13	336	5.4	1.27	4,500	2.1	0.13	14.50*
Support group meeting	7521	3.5	0.16	616	9.9	1.43	6,881	3.3	0.15	54.75*
Hypnosis	5190	2.4	0.12	251	4.0	0.89	4,934	2.3	0.12	5.57*
Yoga/Tai chi/Qi gong	24456	11.2	0.29	1,067	17.0	1.83	23,389	11.0	0.29	14.76*
Yoga	21570	10.0	0.27	860	13.7	1.66	20,710	9.9	0.27	6.83*
Tai Chi	6241	2.9	0.14	512	8.2	1.52	5,729	2.7	0.14	32.11*
Qi Gong	1299	0.6	0.07	111	1.8	0.82	1,188	0.6	0.06	6.77*
Energy Healing	3561	1.64	0.10	158	2.5	0.63	3,402	1.6	0.10	3.02*

[§]Non-mineral / non-vitamin dietary supplements

*p<.05

Table 3. Multivariate regression analyses examining predictors of complementary medicine use

	Model A			Model B			Model C		
Variable	OR	CI	$X^{2§}$	OR	CI	$X^{2§}$	OR	CI	$X^{2§}$
Model A variables									
ADHD									
Yes	1.86	1.45, 2.39	24.18*	2.15	1.66, 2.78	33.87*	1.68	1.282, 2.188	14.30*
Model B variables (added)									
Age (SD)				1.01	1.007, 1.012	51.05*	1.01	1.001, 1.012	51.85*
Gender (%)									
Male				.696	.652, .743	116.08*	.72	.676, .772	92.52*
Ethnicity (%)									
White				Ref	-	-	Ref	-	-
Black/AA				.54	.490, .604	86.75*	.56	.503, .624	80.23*
AIAN				1.48	1.076, 2.041	10.67*	1.51	1.095, 2.071	11.02*
Asian				.78	.637, .953	5.11*	.83	.677, 1.020	2.79
Multiple race				1.30	.974, 1.724	6.26*	1.23	.928, 1.628	4.05*
Marital status (%)									
Married/living together				Ref	-	-	Ref	-	-
Previously married				1.04	.942, 1.114	.78	.95	.858, 1.046	.56
Never married				.98	.887, 1.085	.48	.98	.881, 1.078	.0005
Education (%)									
Bachelors or higher degree				Ref	-	-	Ref	-	-
Some college / AA degree2				.69	.627, .754	12.63*	.64	.586, .705	7.36*
≤ High school / GED (1)				.36	.332, .396	546.20*	.34	.308, .369	569.79*
Employment status									
Employed				1.24	1.151, 1.338	31.30*	1.42	1.321, 1.540	82.45*
Model C variables (added)									
Depression									
Yes							1.23	1.073, 1.405	8.87*
Anxiety									
Yes							1.90	1.658, 2.175	85.57*
Insomnia									
Yes							2.13	1.916, 2.359	201.48*

§ Wald chi-square tests

*p<.05