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Haram Abdelmajid Date 04/23/2018

Maternal Immigrant/Native Status and the Development of ADHD Symptoms and ADHD Diagnosis in Their Children at age 9 years: A Longitudinal Study

By

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MPH

Epidemiology

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ABSTRACT

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As of 2016 there were 43.7 million legal and illegal immigrants living in the United States according to U. S Census Bureau, with an increasing number of immigrants every year, and increasing number of children born in immigrant families. Many of the immigrant families suffered negative life events, and many are living under stressful situations in the host country, which has a negative impact on their children's psychological wellbeing and leads to higher risk of behavioral problems, like attention deficit hyperactivity disorder (ADHD). ADHD is one of the most common neurobehavioral disorders of childhood that persists in adult life in 30 – 50 percent of cases, which significantly impacts their social and academic performance. In this study we are examining whether the mother's immigrant/nativity status is associated with increased risk of developing ADHD symptoms and diagnosis in their 9-year-old children. This association was investigated by conducting a longitudinal study, using the Fragile Families and Child Wellbeing Study (FFCWS) data, a sample of 4898 families from large cities in the United States. In FFCWS, parents or caregivers were asked questions about their child's behavior using Child Behavior Checklist scale. The results of the study showed that children born to immigrant mothers are less likely to be reported as having ADHD symptoms, and less likely to be diagnosed as having ADHD. Although the study showed protective effect of mother's immigration on children's risk of ADHD, this could be due to the attitudes and beliefs of some immigrants towards behavioral problems.

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BACKGROUND AND LITERTURE REVIEW

Hypothesis

Children born to immigrant mothers have been subjected to more negative life events and lower socioeconomic circumstances, and possible discrimination in the host country, which puts them at an increased risk of mental disorders including ADHD compared to children born to native mothers.

The aim of this study is to examine whether children born to immigrant mothers are at increased risk of ADHD at age 9 years than children born to native mothers, in order to be able to specify the needs of this group of population and allocate the required healthcare and preventative services accordingly.

Background

Attention deficit hyperactivity disorder (ADHD) is the most common and most studied neurobehavioral disorder of childhood onset (Rowland et al. 2002). From public health perspective the origin of the disorder and the preventable risk factors are not adequately studied and poorly understood (Rowland et el. 2002). ADHD or hyperkinetic disorder (WHO name) is a chronic disorder, characterized by symptoms of inattention and/or impulsivity and hyperactivity. According to DSM – V "a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with normal functioning or development". Requirements for ADHD diagnosis in children are: Six or more of the symptoms that have been present for a minimum of six months, in at least two settings (example school and home) that are not appropriate for the level of development (Visser et al 2014). People with ADHD have significantly increased rates of accidental injuries, emergency room visits, conflicts with friends and peers, and poor academic performance (Visser et al. 2014), also they are more susceptible to engagement in high risk behaviors like smoking, alcohol and substance abuse, and risky sexual behaviors (Rowland et al. 2002). Nearly one-third to half of children with ADHD will continue to have the disorder through their adulthood (Visser et al. 2014).

Underlying risk factors for ADHD can be divided into biological and environmental factors (Singh A. et al. 2014) as well as the interaction between these factors. Biological factors include genetic factors, which have been recognized as strong risk factors for ADHD, with higher prevalence observed among relatives of children with the disorder for example if one parent has ADHD the risk of having a child with ADHD is 57% (Singh A. et al. 2014), and brain structure, a lot of studies using brain scanning technology

suggested the presence of abnormal brain morphology in regions related to inhibition and attention (Ajay Singh et al. 2015). The other group of risk factors is environmental factors which include prenatal and perinatal risk factors, such as smoking during pregnancy, preterm and low birth weight (Venla Lehti et al. 2016), other risk factors are adverse social events, family discordance, and poor parenting styles (Rydell et al. 2009).

Although genetic risk factors are the major contribution to the etiology of ADHD, environmental risk factors are more likely to be preventable and more suitable for directing interventions (Rowland et al.2002).

With the growth of crises and conflicts around the world, people continue to flee their countries and relocate in other countries, including United States in which the number of immigrants has grown to reach 40.3 million in 2011 (Singh et al. 2013). As the immigrant population continues to grow, more public health attention is needed to address the health problems and allocate preventive services for this group. The immigrant population differs considerably from the U.S born population in their health, disease, access to health service behavior, and behavioral problems risk. Additionally, the socioeconomic differences between native and immigrant families, and the process of adaptation or acculturation changes the immigrants risk for diseases (Singh et al. 2013). It has been suggested that the settlement of immigrants in communities of immigrants from similar cultural heritage benefits their mental health, while disconnection from their cultural heritage will increase their risk to mental illness (Tan et al. 2016). Approximately 43% of the refugees are children under 18 years old (Derluyn et al. 2007), have been subjected to traumatic, and negative life circumstances, and consequently have an increased risk of behavioral problems including ADHD.

The results from previous studies concerning prevalence of ADHD symptoms and or diagnosis, and other behavioral problems in children who are themselves immigrants or were born to one or both immigrant parents are conflicting, some have shown increased prevalence, while others showed same or even lower prevalence than children born to both native parents (Venla Lehti et al. 2016). These inconsistent results can be explained by the variations in study settings, and problems in methodology (Venla Lehti et al. 2016). It has also been noted that the use of ADHD medication is less common among children from immigrant families which might be attributed to social and cultural beliefs, attitude of immigrants towards seeking professional care for behavioral problems that they consider as misbehavior rather than an illness (Yao K-N et al, 1988), and limited access to healthcare.

DSM-V diagnostic criteria for ADHD (cited in Rowland AS. et al, 2002):

Symptoms of inattention are:

- Often unable to pay close attention to details or makes mistakes

- Often has difficulty to keep up attention in tasks or activities
- Often does not seem to listen when spoken to directly.
- Often does not follow through on instructions.
- Unsuccessful in completing schoolwork or work tasks.
- Often stays away, dislikes or is hesitant to participate or became a part of activities that need a sustained mental effort
- Is easily distracted by extraneous stimuli.
- Often forgetful in daily activities.
- Often loses things that are important for daily activities.

Symptoms of hyperactivity and impulsivity are:

- Often fidgets with or taps hands and feet, or squirms in seat.
- Often leaves seat in situations when remaining seated is expected.
- Often runs and climbs in situations where it is inappropriate.
- Often unable to play or engage in leisure activities quietly.
- Often 'on the go' acting as if 'driven by a motor'.
- Often talks excessively.
- Often blurts out answers before a question has been completed.
- Often has difficulty waiting turn.
- Often interrupts or intrudes on others.

ADHD has been classified into three different presentations according to DSM-V (Rowland AS. et al, 2002) , which are combined presentation where inattention, hyperactivity and impulsivity are present and there are six or more symptoms of inattention and six or more symptoms of hyperactivity/impulsivity present for six months or more, predominantly inattentive presentation where six or more symptoms of inattention, but less than six symptoms of hyperactivity have been present for six months or more, and predominantly hyperactive/impulsive presentation where six or more symptoms of hyperactivity/impulsivity, but less than six symptoms of inattention have been present for six months or more.

Since there is no objective laboratory test for ADHD, parent and teacher rating scales or reporting about the children's behavior over the last six months is the most significant method of diagnosing ADHD. The most widely used rating scales to assess behavioral symptoms are the Child Behavior Checklist (CBCL) and Conner's Parent and Teacher rating scales.

CBCL which is used in this study, is a set of measures for assessing children's behavior between ages 4 and 18 years old, using parent, teacher, and self-reports (Achenbach, T. M. 1991). CBCL includes eight constructs or syndromes of which is the attention problem is used for assessing ADHD (Achenbach, T. M. 1991). The form can be

completed independently by the caregiver, or by an interviewer, items are coded 0 to 2, raw scores then converted to T scores with a mean of 50 and standard deviation of 10.

The Conners Parent and Teacher rating scales have commonly been used in the evaluation of children's behavior problems (Yao et al. 1988). The teacher rating scale has two versions as cited in Yao et al 1988, original version which has 39-items, and revised version which has 28-items.

The overall prevalence estimates of ADHD vary considerably between 3% and 11% with variation in age and sex (Ajay Singh et al. 2014) prevalence estimates of ADHD in the U.S have been collected from different sources of data, its analysis has documented increases in ADHD prevalence (Visser et al. 2014). According to the National Survey of Children's Health (NSCH) report from the years 2003, 2007, and 2011, there is an increase in the prevalence estimates of ADHD in children aged 4 – 17 years by 22% from 2003 – 2007 (Visser et al. 2014), with an average increase of 5.5 percent per year. Visser et al. 2014 "estimated prevalence of ever-diagnosed ADHD was 7.8%, 9.5%, and 11% in 2003, 2007, and 2011 respectively".

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Abstract

As of 2016 there were 43.7 million legal and illegal immigrants living in the United States according to U.S Census Bureau, with an increasing number of immigrants every year, and increasing number of children born in immigrant families. Many of the immigrant families suffered negative life events, and many are living under stressful situations in the host country, which has a negative impact on their children's psychological wellbeing and leads to higher risk of behavioral problems, like attention deficit hyperactivity disorder (ADHD). ADHD is one of the most common neurobehavioral disorders of childhood that persists in adult life in 30 – 50 percent of cases, which significantly impacts their social and academic performance. In this study we are examining whether the mother's immigrant/nativity status is associated with increased risk of developing ADHD symptoms and diagnosis in their 9-year-old children. This association was investigated by conducting a longitudinal study, using the Fragile Families and Child Wellbeing Study (FFCWS) data, a sample of 4898 families from large cities in the United States. In FFCWS, parents or caregivers were asked questions about their child's behavior using Child Behavior Checklist scale. The results of the study showed that children born to immigrant mothers are less likely to be reported as having ADHD symptoms, and less likely to be diagnosed as having ADHD. Although the study showed protective effect of mother's immigration on children's risk of ADHD, this could be due to the attitudes and beliefs of some immigrants towards behavioral problems.

INTRODUCTION

In this study, we are examining the association between the effect of maternal immigration status on the development of ADHD symptoms in children aged 9 years old who were born here in the United States. Further we want to examine whether this association is affected by spousal and or family support.

The aim of this study is to examine if the risk of developing ADHD symptoms in children of 9 year, is different among children born to immigrant mothers compared to children born to native mothers in the United States, using fragile families and child wellbeing data (FFCWS), and whether this risk is different for ADHD diagnosis as well, to be able to allocate healthcare and preventive services according to their needs. Several studies using FFCWS data confirmed increased child behavioral problems in both single-parent and cohabiting families (Waldfogel J. et al 2010), but we want to examine the effect of mother's immigrant vs. nativity status on children development of ADHD.

Attention deficit hyperactivity disorder (ADHD) is one of the most common childhood onset neurobehavioral disorders, characterized by persistence of in-attention, hyperactivity, and/or impulsivity, observed in more than one setting (for example Home and school), for at least 6 months (Visser et al, 2014). ADHD can result into increased rate of non-accidental injuries, problems with friends, and impaired academic and or occupational achievement (Visser et al, 2014). ADHD can persist into adulthood in up to 30 to 50% of the cases (Lingineni RK et al, 2012). There are several risk factors associated with ADHD, such as genetic factors, obesity, maternal smoking during pregnancy, low birth weight and prematurity, family structure, socioeconomic status, some environmental toxins, and maternal mental stress during pregnancy (Singh A. et al, 2014, Lehti V. et al, 2016).

According to National Survey of Children's Health (NSCH) data from 2007, nearly 11% of children 4 – 17 years old have a history of ADHD diagnosis, and out of those 83% were currently having ADHD symptoms, from those with current diagnosis 69% were on treatment (Visser et al,2014). There is significant increase of ADHD symptoms reported by parents, ADHD diagnosis, and ADHD treatment from 2003 to 2011. For example, the estimated increase in ADHD prevalence between 2003 and 2007 was 22% with 5.5% annual rate (Visser et al, 2014), and there is greater increase in prevalence of ADHD among minority groups including immigrants who has been considered as lower risk in the past.

There is a substantial increase in the number of foreign born population in the U.S, for example it is estimated that in 2011 there were 40.4 million immigrants an increase of

30.8 million since 1970, which is equivalent to 13% of the total population (Singh GK. et al, 2013). The number of children in immigrant families has increased from 8.2 million in 1990 to 17.5 million in 2011. In 2011, 24.4% of the U.S children had at least one foreign born parent (Singh GK. et al, 2013). With further increase in the immigration due to ongoing world crises and according to the Department of Homeland Security website there were 1.13 million new documented immigrants in 2017. It is important to identify the health problems and health needs of immigrant population.

There is a big difference between immigrant and native population in health, disease, behavioral and socioeconomic profiles, and there is evidence that cultural modification affects the health and behavioral risks of immigrants (Tan et al, 2016). Children of immigrants have different exposures and experiences, language barrier, in addition to stress of immigration and being part of a minority group, all these together, put them in a position of social disadvantage. This will theoretically increase their risk for behavioral and psychiatric disorders. The fact that children and adolescents with ADHD are more likely to engage in risky behaviors and as a result more likely to utilize health and mental health services, make it necessary for policy makers to have research knowledge to enhance their ability to plan health services and allocate prevention programs and interventions for each group of the population including immigrant population.

Studies on ADHD in immigrant population are few in comparison to other neuropsychiatric disorders and have shown inconsistent findings, while some studies found increased risk, other studies showed equal or decreased risk of ADHD symptoms and/or diagnosis compared with children of non-immigrant parents (Singh GK. et al, 2013, Tan TX. et al, 2016, Venla Lehti et al, 2016). Studies on the use of ADHD medications has showed less use of medication among immigrant population which can be explained by cultural beliefs and negative attitudes towards medication, in addition to limited access to healthcare system (Ghosh M. et al, 2014).

According to a study by Singh G. K in the U.S, it found that children who were born to either one or two immigrant parents had a lower prevalence of ADHD than babies born to both native parents (Singh G. K et al, 2013). With increase in the immigration in the last few years, comparing incidence of disease in children with different life experiences might yield some suggestions about the causation.

METHODS

Design

The current study is a retrospective longitudinal study measuring the association of mother's immigration status on their children's expression of ADHD symptoms or having ADHD diagnosis at age 9 years using FFCWS.

Sample

FFCWS data is a cohort study of nearly 5000 children who were born between the years 1998 and 2000, in large cities (cities with population more than 200,000) in the United States (Reichman NE, 2001).

The data collection included 3 stages, first stratified random sample of 20 cities were selected from large U.S. cities (Reichman NE, 2001), 75 hospitals were selected randomly from these cities (Reichman NE, 2001), then a random sample of children born to married and unmarried mothers. Children born to unmarried mothers were oversampled, they constitute around 3,700 out of the total sample (Reichman NE, 2001), interviews were done at birth and subsequently at ages 1, 3, 5, 9, and 15 years (Reichman NE, 2001). The data contains information about child development, health and behavior, child-parent relationship, the relationship between parents, family structure, parent's nativity status, parent's race, and parent's country of birth, and citizenship status. 16.97% of the mothers, and 14.25% of the fathers from the original sample in Fragile families were foreign born. Data on children's behavior were collected by questioning mothers, fathers, and teachers, about symptoms of in-attention and hyperactivity, and asking mothers whether the child has been diagnosed as having ADHD by a healthcare provider.

However, the number of participants has declined overtime, 4,055 were participated on the core survey at age 5, and 3,515 were participated on mother interviews at age 9, while 2,254 participated in teacher survey.

The sample used for this study is different from the original sample to loss to follow up at age 9 years, and the final sample used for analysis contains 2,958, with lower number and proportion of immigrant mothers than the original sample.

Outcome Measure

T score for ADHD Symptoms at age 9 years was constructed from a combination of 10 Child Behavior Check List (CBCL) questions to the mother/caregiver. All questions have three answer options, not true = 0, somewhat true = 1, and very true = 2. The raw sum for each child was calculated, and T scores were generated by using the following formula which was used to calculate T score in SPSS:

$$\left(\frac{sample\ mean - raw\ sum\ for\ each\ child}{standard\ deviation}\right)*10 + 50$$

Those with T score 60 or more are considered having ADHD symptoms and assigned the value of 1, and those who score less than 60 assigned the value of zero.

ADHD Diagnosis was included in this study as one of the outcomes. In wave 5 the primary care givers were asked whether the child was diagnosed by a healthcare provider as having ADHD or ADD and those whose response was "yes" were assigned the value of 1, and those whose response was "no" were assigned the value of zero.

Covariates

Sex

Sex is included as a covariate, because ADHD symptoms and diagnosis are more commonly observed in males than females, however the difference in the diagnosis might be attributed to referral-bias (M. Huss et al, 2008), (male = 1, female = 0).

Mother age

It has been indicated in many studies that maternal age is associated with increased risk of ADHD, also there is indirect association, since low birth weight, pre and post-maturity, and birth asphyxia, are associated with maternal age, and considered to be risk factors for ADHD (Biederman et al, 2005). In FFCWS data, mother's age ranges between 15 – 43 years, mother age was included as continuous variable in analysis.

Marital status:

It has been reported that family structure associated with neurobehavioral disorders, and the risk is higher in children who live with one parent compared to those who live with two parents (W. J. Choi et al, 2016). For this analysis, new variable was created from 2 constructed variables in fragile families married to the baby's father or cohabitated with baby's father.

Smoking during pregnancy

The association of maternal smoking with ADHD, externalizing disorders, and other psychiatric conditions have been studied extensively. Fetal exposure to nicotine can affects the developing brain at critical points (Biederman et al, 2005), and is associated with increased ratio of these disorders in the exposed children. However, nicotine acts as stimulant and maternal smoking might be an indicator of mother's ADHD status (A. S Rowland et al, 2002). In wave one, the mothers were asked about smoking during pregnancy with response options: 2 or more packs a day assigned the value of 1, 1 or more but less than 2 assigned the value of 2, Less than 1 pack a day assigned the value of 3, and None assigned the value of 4. In this analysis the new variable was created to include smoking as dichotomous variables with mothers who smoked while pregnant with the child equal to 1 and those who did not smoke during pregnancy assigned zero.

Physical Violence towards the child

The relationship between ADHD and negative parenting might be reciprocal relationship, where parental maltreatment influences ADHD symptoms, and child behavior influences negative parenting. In this study although child maltreatment has been represented in several ways as part of conflict tactics scale measure in FFCWS data, we used mother's report of physical violence as an indicator of child maltreatment, and we constructed a new variable ranging from never experienced physical violence, experience physical violence few times per month, or every week experience physical violence.

Maternal Education and Poverty Category

The association between parental education and socioeconomic status and ADHD symptoms have been reported in several studies (Rydell et al, 2009). Education is included as a constructed variable of 5 categories, less than high school, high school Diploma or GED, some college or technical school, and college or graduate school.

Poverty category is a constructed variable of 5 categories 49% less than poverty level, 50 – 99%, 100 – 199%, 200 – 299%, and 300% or more.

Access to Healthcare

Access to healthcare affect the probability of being diagnosed, and was measured by having health insurance, in each wave mothers were asked whether the children living in the household have either private health insurance or public health insurance which is included as having private/public insurance or no insurance variable in the analysis.

Statistical Analyses

This sample is different from the original sample due to exclusion of the missing observations from all variables which affect the number and the proportion of the immigrant mothers and the number from different ethnic origins among immigrants except those of Hispanic origin, became very scarce. The final sample used for the analysis is 2,958 observations out of 4,055. Data was analyzed using Statistical Analysis Software (SAS), the main research question was investigated using logistic regression models, no collinearity was detected. All covariates, maternal age, mother martial-status, and maternal education at the time of child birth, maternal smoking during pregnancy, child sex, physical maltreatment of the child, and poverty category, and access to healthcare at age 9 years, were tested for interaction using chunk test and backward elimination, however no interaction was detected. Both crude and adjusted association (for the former mentioned covariates) between the predictor variable mother immigrant vs. nativity status and the outcome variables ADHD symptoms and diagnosis were measured.

Although no interaction by sex was detected, we performed secondary analysis where we stratified by gender, then we examined the association of ADHD symptoms and diagnosis in children born to immigrant women who are from Hispanic origin, compared to those from non-Hispanic origin

RESULTS

First the results of analysis looking into descriptive statistics, as shown in Table 1. Out of 2,958 mothers, Immigrant mothers constitute 13.5 percent. At age 9, 13.7 percent have reported symptoms of ADHD, and 11.3 percent have been diagnosed as having ADHD by a healthcare provider, which is comparable to previous studies. In terms of demographics, 52.7 percent of the children are males, mean maternal age is 25.1 years and ranges between 15 and 45, and 18 percent of mothers are less than 20 years old, 18.40 percent of the mothers smoked during pregnancy, and 4.7 percent have no public or private insurance. Approximately 37.3 percent of mothers do not have high school diploma or GED, while 10.5 percent have either college or graduate degree. About 36 percent of mothers are below 100 percent of federal poverty level, and 20 percent have income above 300 percent federal poverty level. Forty percent of mothers were single, 23.5 percent were cohabitating with the baby's father, and 36 percent were married to the baby's father at the time of birth, but the family structure kept changing throughout the study period. Approximately 50 percent of children at age 9 years, in the sample suffered from some sort of physical maltreatment.

ADHD Symptoms

The crude association between mother's immigrant/native status and ADHD in children as displayed in Table 2, showed that 9 year old children born to immigrant mother are less likely to have ADHD symptoms compared to children born to native mothers (OR 0.49, 95% CI (0.33, 0.72)P < .0003)), however this association remained the same after controlling for maternal age, sex of the child, maternal marital status, maternal education, poverty category, maternal smoking during pregnancy, physical violence towards the child, and access to healthcare, as shown in Table 2.

ADHD Diagnosis

Regarding the second outcome ADHD diagnosis, the crude association as displayed in Table 2, children who were born to native mothers are approximately 67% more likely to be diagnosed with ADHD than children born to immigrant mothers (OR 0.33, 95% CI (0.21, 0.54)).

After adjusting for sex, maternal age, mother's marital status, maternal education, poverty, physical violence towards the child, maternal smoking during pregnancy, and access to healthcare as measured by having private or public insurance the odds of ADHD Diagnosis in 9 year old children who born to native mothers are 63% more likely to have ADHD diagnosis than 9 year old children born to immigrant mothers (OR 0.37 95% CI (0.22, 0.61) P < .0001).

Secondary analysis

When examining the association between mother nativity/immigrant status and ADHD symptoms and diagnosis stratifying on sex, as shown in Table 3, both boys and girls born to immigrant mothers are less likely to report ADHD symptoms and less likely to be diagnosed compared to those born to native mothers in both crude and adjusted associations, however these associations were not statistically significant for ADHD symptoms in females.

Also, we did analysis by comparing the association of both ADHD symptoms and diagnosis in children who were born to immigrant mothers of Hispanic origin and those who were born to immigrant mothers of non-Hispanic origin. Both crude and adjusted associations were illustrated in Table 4. For the ADHD diagnosis, the crude association showed that children born to mothers from Hispanic origin are 65 percent less likely to be diagnosed with ADHD than children born to mothers from non-Hispanic origin (OR 0.65 (0.25, 1.74)) P = 0.4012), and after adjusting for mother age, mother's marital status, poverty category, mother's education, physical maltreatment of the child, sex of the child, access to healthcare, and maternal smoking during pregnancy this relationship shifted towards the null (OR 0.78 (0.28, 2.21) P 0.6407), but both of these associations are not statistically significant. When examining ADHD symptoms, the crude association showed that, children born to Hispanic mothers are 19 percent more likely to be reported as having ADHD symptoms than children born to mothers from non-Hispanic origin (OR 1.19 (0.52, 2.76) P 0.6812), after adjusted for the above mentioned covariates this association became more apparent (OR 1.45 (0.59, 3.55) P 0.4214), however this association was not statistically significant as well.

DISCUSSION

This study showed that 9-year-old children who were born to immigrant mothers have significantly lower likelihood of both ADHD symptoms reporting and ADHD diagnosis. This result is comparable to the results from two previous studies done here in the U.S. by Singh et al 2013 and Tan et al. 2016, which have found lower likelihood of association between immigrant background and neurobehavioral disorders. This could be explained by the acculturation effect, or immigrant paradox (Tan et al, 2016), "positive immigrant selectivity in health" (Singh et al, 2013), and the higher levels of social support as immigrants tend to reside in areas with people from same cultural background.

This observed protective effect which appear more protective in ADHD diagnosis, where children born to native mothers are 67% more likely to be diagnosed than children of immigrant mothers, might be attributed to the characteristics of immigrant mothers towards behavioral problems of children (Johnson et al, 2005, Yao K-N. et al, 1988), considering it as misbehavior and not illness that needs medical attention which may lead to less symptom reporting and less likelihood of seeking medical advice and being diagnosed, and the social stigma associated with mental health problems. Another factor that might affect this association is that ADHD is not easy to diagnose. The immigrant group is non-homogenous group, with cultural differences and variation in patterns of acculturation, which might account partially for the observed differences.

In contrast to what we found in this study and previous studies here in the U. S and one study from Belgium (Derluyn I et al, 2008), studies from other European countries, for example studies from Sweden (AM Rydell et al2010), and Finland (Lehti V et al, 2016), have found the reverse, this might be attributed to the differences in the study designs, the conditions that are surrounding immigrant populations in these countries, or the genetic variations between populations who immigrated to European countries compared to those who immigrated to United States.

The differences that we have observed between children of mothers from Hispanic origin who have more ADHD symptom reporting and lower likelihood of ADHD diagnosis than other ethnicities might be due to genetic and cultural variations or because the sample size is too small to detect differences.

STRENGTHS &LIMITATIONS

Strengths

While most of the previous studies of the association between ADHD symptoms and diagnosis are cross sectional studies, this study is a cohort study with a large sample size despite the relatively small number of immigrant families in the sample. Extensive information has been collected throughout the study period which made it easier to control for multiple covariates.

Limitations

The large number of loss to follow up and exclusion of missing observations reduced the sample size and to a greater extent the number of immigrant mothers in the final sample used for analysis, which make it difficult to control for the country of origin, second the reporting of both ADHD symptoms and diagnosis based on parent/caregiver report which will introduce information bias, third while covariates were measured several times during the study period, we included only the baseline measures for maternal education, poverty category, and family structure in the final analysis, fourth in this study we did not adjust for covariates like prematurity, and low birth weight which are considered risk factors for ADHD, fifth the physical maltreatment covariate included only physical maltreatment of the mother towards the child, but did not account for other types of maltreatment, and physical maltreatment by other members in the household. Finally, the FFCWS data was mainly collected from high risk families, which restricts the generalizability of the results.

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TABLES

Table1. Descriptive Statistics

Variable	Percentage %
N 2,958	
Born in the US	
Yes	86.54
No	13.46
ADHD Diagnosis[a]	11.33
ADHD Symptoms[a]	13.73
Mother's Age[b]	
15 – 19	18.15
20 – 39	79.62
40 – 45	2.23
Mothers Marital Status[b]	
Single	40.26
Married to Father	23.50
Cohabitate with the Father	36.24
Poverty Category	
0 – 49%	16.80
50 – 99%	20.08
100 – 199%	29.41
200 – 299%	14.13
300+%	19.57
Level of Mother Education	
Less than high school	37.25
High school/GED	26.81
Some College/Technical	25.46
College/Graduate School	10.48
Physical Violence towards the child[c]	
Never experienced Violence	49.56
Physical maltreatment 1 – few times/Month	36.58
Few times/week – every day	13.86
Access to health insurance	
Yes	95.33
No	4.67
Sex[d]	
Male	52.74
Female	47.26
Maternal smoking During Pregnancy	
Yes	18.39
No	81.61

Abbreviations, ADHD Attention Deficit Hyperactivity Disorder (SD), Number (N).

a: as reported by the mother or caregiver, b: at the time of child birth, c: at age 9 years, d: child's sex

Table 2. Crude and Adjusted Association Between ADHD Diagnosis and ADHD Symptoms

Exposure	**Crude**	**Adjusted[a]**
N (2,958)	OR (95%CI)	OR (95%CI)
Mother Born in U. S (outcome ADHD Diagnosis)	0.33(0.21, 0.54)	0.37(0.22, 0.61)
Mother Not Born in U. S (outcome ADHD Symptoms)	0.49(0.33, 0.72)	0.53(0.36, 0.79)

Abbreviations: Odds Ratio (OR), 95% Confidence Interval (95%CI), N: number

a: Adjusted for mother's age, mother's marital status, poverty category, mother's education, physical maltreatment of the child at age 9 years, access to healthcare, sex of the child, and maternal smoking during pregnancy.

Table 3. Crude and Adjusted Association Between Maternal Native/Immigrant Status and ADHD Symptoms and Diagnosis Stratified by Gender

Sex	Exposure	Crude		Adjusted[a]	
	N (2,958)	OR	95%CI	OR	95%CI
Male	Mother Not Born in U. S (ADHD Symptoms)	0.46	(0.29, 0.74)	0.52	(0.32, 0.85)
	Mother Not Born in U.S(ADHD Diagnosis)	0.31	(0.18, 0.56)	0.37	(0.21, 0.67)
Females	Mother Not Born in U. S (ADHD Symptoms)	0.51	(0.26, 0.99)	0.55	(0.28, 0.1.09)
	Mother Not Born in U. S (ADHD Diagnosis)	0.35	(0.14, 0.88) .03	0.38	(0.15, 0.95)

Abbreviations Odds Ratio (OR), Confidence Interval (CI), P-value (P). N: number

a: Adjusted for mother's age, mother's marital status, poverty category, mother's education, physical maltreatment of the child at age 9 years, access to healthcare, sex of the child, and maternal smoking during pregnancy.

Table 4. The Crude and Adjusted association between mother's Immigrant and of Hispanic Compared to Immigrant from non-Hispanic Origin and ADHD Symptoms and Diagnosis.

Exposure	**Crude**	**Adjusted[a]**
N (2,958)	OR (95%CI)	OR (95%CI)
Hispanic vs. non-Hispanic Origin (ADHD Symptoms)	1.19 (0.52, 2.76)	1.45(0.59, 3.55)
Hispanic vs. non-Hispanic Origin (ADHD Diagnosis)	0.66 (0.25, 1.74)	0.78 (0.28, 2.21)

Abbreviations: OR (Odds Ratio), CI (Confidence Interval), N: number.

a: Adjusted for mother's age, mother's marital status, poverty category, mother's education, physical maltreatment of the child at age 9 years, access to healthcare, sex of the child, and maternal smoking during pregnancy.

SUMMARY AND FUTURE DIRECTIONS

There is continuous change in population dynamic in the developed countries due to migration. In the United States the population reached 441 million because of migration (Biederman et al, 2005), and most of the recent immigrants to the U.S. are from non-European descent (Tan et al, 2016). With this increase in the influx of the refugee, information about immigrant background and behavioral problems including ADHD is important for policymakers (Venla Lehti et al 2016).

Although this study showed that there is lower association of mother's immigrant status and the likelihood to report ADHD symptoms and diagnosis which is correlated with some of the previous studies, further studies are needed using a larger number of children born to immigrant mothers and more representative sample of the entire population, that account for cultural differences between immigrant groups. Also, it is important to use more accurate measures of ADHD diagnosis like medical records rather than self and parental reports.