

## **Parental immigration and offspring post-traumatic stress disorder: a nationwide population-based register study**

Sanju Silwal<sup>1\*</sup>, Venla Lehti<sup>1,2,3</sup>, Roshan Chudal<sup>1</sup>, Auli Suominen<sup>1</sup>, Lars Lien<sup>4,5</sup>, Andre Sourander<sup>1,6</sup>

<sup>1</sup>Department of Child Psychiatry, Research Centre for Child Psychiatry, University of Turku, Turku, Finland

<sup>2</sup> Department of Psychiatry, Helsinki University Hospital and University of Helsinki, Helsinki, Finland

<sup>3</sup> Mental Health Unit, National Institute for Health and Welfare, Helsinki, Finland

<sup>4</sup>Norwegian National Advisory Unit on Concurrent Substance Abuse and Mental Health Disorders, Innlandet Hospital Trust, Brumunddal, Norway

<sup>5</sup>Department of Public Health, Inland Norway University of Applied Sciences, Elverum, Norway

<sup>6</sup>Department of Child Psychiatry, Turku University Hospital, Turku, Finland

### **\* Corresponding Author**

Sanju Silwal

Lemminkäisenkatu 3 / Teutori (3. floor)

20014, Turku, Finland

E-mail: [sanju.silwal@utu.fi](mailto:sanju.silwal@utu.fi)

Phone: +358-469677076

## **Abstract**

### Objectives

The aim of this study was to investigate the association between parental immigration status and a diagnosis of post-traumatic stress disorder (PTSD) in their offspring.

### Methods

This nested matched case-control study was based on a Finnish national birth cohort for 1987-2010 and cases were diagnosed with PTSD by 2012 from the Care Register for Health Care. We identified 3639 cases and 14434 controls individually matched for gender, place and date of birth ( $\pm 30$  days). Conditional logistic regression analyses were conducted to examine the association between parental immigration status, parents' region of birth and time since paternal immigration, and PTSD after controlling for confounding factors.

### Results

The likelihood of being diagnosed with PTSD was significantly increased among children with an immigrant father (OR 1.8, 95% CI 1.3 - 2.4) than those with two Finnish parents. There was no significant association between having an immigrant mother or two immigrant parents and receiving a diagnosis of PTSD. The likelihood of being diagnosed with PTSD was increased if the children's fathers had migrated less than five years before their birth (OR 1.4, 95% CI 1.03 - 1.9) and if their immigrant fathers had been born in North Africa or the Middle East (OR 2.1, 95% CI 1.4 - 3.3).

### Limitations

The sample included a heterogeneous migrant group without information on the reason for migration. The cases were identified from hospital diagnosis that may have only included severe cases.

### Conclusion

The increased likelihood of a diagnosis of PTSD underlines the need for psychosocial services among second-generation immigrants.

**Keywords:** *Post-traumatic stress disorder, Epidemiology, Immigrants, Parents, Risk factor*

## **Introduction**

Post-traumatic stress disorder (PTSD) is a trauma-and stressor-related disorder that occurs when an individual is exposed to a traumatic event and it is characterized by re-experiencing events, avoiding stimuli, negative alterations in cognition and moods and symptoms of hyper-arousal (American Psychiatric Association, 2013). Research on PTSD among children and adolescents has been extensively conducted over the past two decades and its lifetime prevalence ranges between 0.5% to 15.9% (Alisic, et al, 2014; Copeland, et al, 2007). The symptoms of PTSD in children can persist until adulthood and can cause increase risk for psychiatric disorders, serious disability, medical illness and suicide (Sareen, et al, 2007; Shalev, et al, 2017). The development of PTSD is influenced by genetic and environmental factors and in combination with their interaction (Banerjee, et al, 2017; Koenen, et al, 2008).

Migrant children, particularly refugees, often experience traumatic events prior to, or during, migration, which is strongly linked to PTSD and other mental health problems (Fazel, et al, 2005; Fazel, et al, 2012; Reavell and Fazil, 2017). Several studies have shown an increased risk of PTSD among first generation migrant children (Angel, et al, 2001; Fawzi, et al, 2009; Gaber, et al, 2013; Jaycox, et al, 2002; Lien, et al, 2006; Perreira and Ornelas, 2013). Much less is known about second-generation immigrants. The risk of PTSD among this group is of interest for two reasons. First, there is increasing evidence of intergenerational transmission of trauma among the children of Holocaust survivors, refugees and veterans (Bezo and Maggi, 2015; Dekel and Goldblatt, 2008; Han, 2006; Yehuda, Rachel, et al, 2007). Parental traumatization seems to impair parenting capacities and attachment relationship with their children and increase the risk of traumatic events in the family (van Ee, et al, 2016). Second, the incidence of many psychiatric disorders have been shown to be higher among second-generation immigrants compared with first generation immigrants, however studies of PTSD among second-generation immigrants are limited (Bourque, et al, 2011; Cantor-Graae and Pedersen, 2013; Mindlis and Boffetta, 2017).

To date, there have been two studies that have specifically examined PTSD among second-generation immigrants. A French population-based study showed that second-generation immigrants had an increased risk of PTSD (Guardia, et al, 2017). However, a US study reported a decreased risk of PTSD among second-generation immigrants compared to first generation migrants and native born subjects (Salas-Wright, et al, 2014). Another Danish register study that

included PTSD in the category of anxiety and somatoform disorders, showed an increased risk among children with one immigrant parent, but a decreased risk among children with two immigrant parents (Cantor-Graae and Pedersen, 2013). However, these previous studies had some limitations. Only a few potential confounders have been examined. Salas-Wright et.al. (2014) adjusted for age, sex, marital status, urbanicity, socio-economic status and substance abuse, Cantor-Graae and Pedersen (2013) only adjusted for age and sex, while Guardia et al. (2017) did not adjust for confounders, which restricts the interpretation of these findings. Furthermore, two of the study samples were small, the study designs were cross-sectional and the diagnoses were based on questionnaires (Guardia, et al, 2017; Salas-Wright, et al, 2014). Due to the limited number of studies, and the conflicting findings and limitation in the designs, there is a need for further studies to shed light on the risk of PTSD among second-generation immigrant children. This study is based on a large nationwide sample of PTSD cases adjusting for several confounders including those that have not been accounted for previously.

In Finland, the population of immigrants has increased rapidly in the past two decades. Foreign born persons living permanently at the end of 2017 was 7.5 per cent of the total population (Statistics of Finland, 2018a). Immigrants in Finland is a heterogeneous group who have migrated mainly from Russia, Estonia, Somalia and Iraq. The most common reasons for migration during 2018 was family reasons (36.2%), work (30.9%), study (20.8%), refugees (11.0%) and others (1.1%) (Finnish Immigration Service, 2019). This nested case-control study was based on a large nationwide sample which includes information of second-generation immigrants, who were diagnosed with PTSD by specialized healthcare services and were born in Finland, with one or both of their parents born abroad. Previous register-based studies in Finland have shown an increased risk of childhood autism (Lehti, et al, 2013), attention deficit hyperactivity disorder (Lehti, et al, 2016) and learning disorders (Lehti, et al, 2018), but decreased risk of Asperger's syndrome, in children with immigrant parents (Lehti, et al, 2015). These studies have suggested several biological and social factors as potential risk factors and discussed challenges in the assessment of migrant children and service use among immigrant families.

The main aim of this study was to examine the association between parental immigration and a diagnosis of PTSD in their offspring. Our literature review revealed a high risk of PTSD in immigrants and intergenerational transmission of PTSD symptoms and/or trauma. The

consequences of traumatic events do not just have an impact on the person exposed, they also affect future generations through genetics and behavioral factors (Han, 2006; Yehuda et al., 2008). Thus, we hypothesized that the children of immigrants would have an increased risk of a PTSD diagnosis compared with two Finnish born parents. In addition, we examined whether the parental region of birth and the period of time since paternal immigration was associated with a PTSD diagnosis.

## **Methods**

This study was based on a nested case-control design, in which the controls for each case were identified from the population at risk and matched on selected factors. Information of cases and controls were obtained from the Finnish national registers: the Care Register for Health Care (Care Register), the Finnish Population Register (Population Register) and the Finnish Medical Birth Register (Birth Register). The registers are linked together by unique personal identity codes that have been issued at birth or on immigration to all Finnish residents since 1964. Approval for the use of the health and population registers data and linkage of data were obtained from the data protection authorities. Ethical approval for the study was provided by the Ethics Committee of the Hospital District of Southwest Finland.

### National registers

A detailed description of the national registers has previously been published and is briefly summarized here (Joelsson, et al, 2016). The Care Register is a continuation of the Finnish Hospital Discharge Register, which has contained information on inpatient diagnoses in public and private healthcare facilities since 1969 and all outpatient care in public hospitals since 1998. It includes personal identity codes, admission and discharge dates, details of any day surgery and a primary along with up to three secondary diagnoses. The diagnoses are coded according to World Health Organization (WHO) International Classification of Diseases – Eighth Revision (ICD-8) (World Health Organization, 1967) from 1969 to 1986, the Ninth Revision (ICD-9) (World Health Organization, 1977) from 1987 to 1995 and the Tenth Revision (ICD-10) (World Health Organization, 1992) from 1996 onwards. The Care Register has been maintained since the 1960s and the computerized data with personal identity codes is available for all diagnoses since 1969.

The Birth Register includes information on all pregnancies, prenatal periods and neonatal periods up to the age of 7 days for all live births in Finland. It also includes still births where the fetuses had reached at least 22 weeks of gestation or had a birth weight of at least 500g.

The Population Register contains basic information about Finnish citizens and permanent residents in Finland. The personal data recorded in the system includes their name, personal identity code, address, country and municipality of birth, native language, family relationships and date of birth, migration and death, if applicable. Asylum seekers and migrants are not included in the Population Register until they receive their personal identification numbers.

#### Case and control identification

All diagnosed cases were singleton births and born in Finland between 1 January 1987 and 31 December 2010 and diagnosed with PTSD by the year 2012. The information about PTSD was based on the following ICD codes in the Care Register: 3098X (ICD-9) or F43.1 (ICD-10). We excluded 7 cases with severe or profound mental retardation and those who were diagnosed before two years old. The total number of identified PTSD cases was 3639.

In Finland, public health services are widely used and specialized psychiatric services are mostly free of charge for both children and adults. Most patients are referred to specialized services by primary health services, including child welfare clinics and school health care. The multi-professional teams that work in specialized psychiatric services are led by child and adolescent or adult psychiatrists. PTSD can be diagnosed based on the characteristic symptoms that are identified during unstructured or structured interviews and the more complex cases are assessed by a psychologist.

The controls were selected from the Care Register and comprised all singletons born in Finland during the study period who were alive and living in Finland when the matched cases were diagnosed. The controls were without any diagnosis of PTSD or severe or profound mental retardation. Each case was matched with four controls based on their date of birth ( $\pm 30$  days), gender and place of birth, resulting in 14434 controls. The cases and controls were linked through the Care Register and the Population Register and the parents were linked to their children by using personal identity codes from the Population Register.

## Parental immigration status

In Finland, the number of immigrants has been relatively small, but it increased rapidly from 1990 to 2016, from around 1.3% of the national population to 6.5% (Official Statistics of Finland., 2018). For this study, we collected information on the parents' country of birth and native language from the Population Register. Immigrant parents were defined as those who were born abroad and were not native Finnish, Swedish or Sami speakers, which are the country's three official languages. Finnish parents were those who were born in Finland and/or whose native language was Finnish, Swedish or Sami. Parental immigration status was divided into four categories: both parents Finnish, immigrant mother and Finnish father, immigrant father and Finnish mother and immigrant mother and immigrant father. The regional analysis on immigration status was based on the parent's country of birth: Finland, Western countries (most European countries, such as North America, Australia and New Zealand); countries that were part of the former Soviet Union or former Yugoslavia; Sub-Saharan Africa; North Africa and the Middle East and Asia (excluding the Middle East). The timing of paternal immigration was based on the difference between dates of immigration and birth of the child and categorized as: at least 5 years before birth and less than 5 years before birth.

## Covariates

The covariates were included on the basis of a bivariate analysis between 1) the selected register-based variables and PTSD and 2) the same variables and the parents' immigration status in the control group. The results of the analyses are shown in Table 1. Information on parental age was obtained from the Population Register, maternal and paternal psychiatric disorders were obtained from the Care Register and information on all the other variables were obtained from the Birth Register. The different categories of variables included in the analysis were: maternal age (< median of 29 years and  $\geq$  median of 29 years), paternal age (< median of 31 years and  $\geq$  median of 31 years), maternal psychiatric disorders (yes or no), paternal psychiatric disorders (yes or no), number of previous birth (0 or at least 1), maternal marital status (married/ in a relationship or single) and maternal socio-economic status (upper white collar, lower white collar, blue collar and other). The maternal and paternal psychiatric category included the ICD-10 diagnoses of F10-99, excluding mental retardation (F70-79), the ICD-9 diagnoses (291-316, excluding 293-294) and the ICD-8 diagnoses (291-308, excluding 292-294).

## Statistical analysis

The analysis of bivariate associations, detailed in Table 1, was conducted to evaluate the relationship between the covariates and the parents' immigration status among controls using Pearson's chi-square test. The covariates were then examined for associations with PTSD. Conditional logistic regression models were used for matched sets to examine the association between parental immigration status and PTSD. The associations were each quantified using an unadjusted odds ratio (OR) and an adjusted odds ratio (aOR) with a 95% confidence interval (95% CI). Covariates were included in the adjusted model if they were associated with the parent's immigration status and PTSD with a p-value of  $< 0.1$ . The reference group for the analysis was Finnish parents. In the unadjusted and adjusted models, a two-sided p-value of  $< 0.05$  was considered statistically significant. The statistical analyses were performed with SAS statistical software, version 9.4 (SAS Institute Inc., Cary, NC, USA).

## Results

The results of the bivariate association analysis between PTSD and socio-demographic and parental mental health problems across parental immigration are shown in Table 1. Maternal and paternal age, maternal and paternal psychiatric disorders, maternal marital status and maternal socio-economic status were associated with PTSD and parents' immigration status and were included in the adjusted analysis.

Table 2 shows the association between having one or two immigrant parents and being diagnosed with PTSD. The likelihood of receiving a diagnosis with PTSD was higher in children with an immigrant father than children with two Finnish parents. The adjusted odds ratios were 1.8 (95% CI 1.3 - 2.4) for the association between an immigrant father and PTSD in their offspring. No significant association was found between two immigrant parents or an immigrant mother with Finnish father and offspring PTSD.

There was a statistically significant association between timing of paternal immigration and being diagnosed with PTSD (Table 3). The likelihood of being diagnosed with PTSD was increased for children whose fathers migrated less than five years before the birth of the child (OR 1.4, 95% CI 1.03 - 1.9).



The results of the regional analysis are shown in Table 4. The father's region of birth was associated with a PTSD diagnosis in their offspring. Children had an increased likelihood of being diagnosed with PTSD if their father was born in North Africa and the Middle East, with an adjusted OR of 2.1 (95% CI 1.4 - 3.3). No significant association was found between the mother's region of birth and PTSD in her offspring.

## **Discussion**

This study had three major findings. First, children born to immigrant fathers were more likely to be diagnosed with PTSD than those with two Finnish born parents. Second, the likelihood of receiving a diagnosis of PTSD was increased among children if their father was born in North Africa or the Middle East. Third, the risk of a PTSD diagnosis was increased in children whose fathers migrated less than five years before the birth of their child.

Parental immigration may increase the risk of traumatic experiences in the family or the children's risk of developing PTSD symptoms after adverse events. There might be some risk factors that are particularly related to fathers or mixed marriages between immigrants and native Finns. First, immigrant fathers and their Finnish partners may represent a select group of parents and the challenges they face may be somewhat different to families with two Finnish or two immigrant parents. It is possible that mixed nationality families are more prone to conflicts due to differences in culture and religion. This is likely to be found in families with immigrant fathers, due to the shift in gender-based economic roles. Pessin and Arpino (2018) have reported that adult migrants hold gender attitudes that reflect more strongly to the country of origin's gender culture which might increase the risk for marital conflict. In addition, the divorce rates are higher among immigrant men married to Finnish women than among immigrant women and Finnish men (Statistics of Finland, 2018b). Marital conflicts and changes in the family environment may expose children to stressful events. For example, children are more likely to witness domestic violence and are at increased risk of physical or sexual abuse (Holden, 2003). Moreover, children of conflict families have elevated risk for negative development outcomes including antisocial behavior, poor academic attainment, criminality and serious mental health problems (Bernet, et al, 2016; Harold and Sellers, 2018; Holmes, 2013).

Second, immigrant fathers are more likely to have traumatic experiences and trauma-related or other psychiatric symptoms compared to immigrant mothers or Finnish parents (Castaneda, et al, 2017; Markkula, et al, 2017). Men are more likely than women to migrate to Finland for work or study or as refugee, while women are more likely to migrate on a family relations so that they can be closer to family members (Statistics of Finland, 2018c). Immigrant men living in Finland have reported more traumatic experiences in their home country than women and severe trauma, such as being tortured, has been reported to be particularly more common among men (Castaneda, et al, 2017). In addition, reports state that immigrant men in Finland are diagnosed with PTSD more often than immigrant women or native Finnish people (Bhugra and Becker, 2005; Markkula, et al, 2017; Schubert, et al, 2019).

Third, intergenerational transmission of PTSD has been reported in various traumatized populations (O'Toole, et al, 2017; Sangalang and Vang, 2017; Yehuda, R., et al, 2001). It has been shown that parental PTSD symptoms can be transmitted to their offspring in a dose-response relationship, that elevates childrens' exposure to traumatic events (Roberts, et al, 2012). There are several mechanisms that may explain this process.. For instance, traumatized fathers could be emotionally unavailable or be more hostile or less sensitive, which might affect their secure attachment to their children and increase the child's vulnerability to PTSD (Galovski and Lyons, 2004; Leen-Feldner, et al, 2013; Timshel, et al, 2017; van Ee, et al, 2016). Parental communication patterns such as being silent or denying traumatic events or disclosing too much information about traumatic events to their children have been found to affect mental health of the child (Dalgaard, et al, 2016). Children's exposure to traumatic events may be related to parental psychopathology through disruptions in family function, divorce, substance abuse and job losses (Breslau, et al, 2003). The social, emotional and cognitive deficit found in the children of parents with PTSD may also put these children at greater risk of trauma (Koenen, et al, 2007; Ozer, et al, 2003; Selimbasic, et al, 2017). In addition, it is possible that the children of traumatized parents will display hyper-arousal, irritability or outbursts of anger, which could, in turn, provoke more violent behavior from traumatized parents (van Ee, et al, 2016). Immigrant fathers could also increase the risk of PTSD in their offspring through genetic factors (Gressier, et al, 2013; Yehuda, Rachel, et al, 2007) or through epigenetic modifications in their sperm (Gapp, et al, 2014). The combination of genetic factors with early environmental factors, such as the quality of the interaction between the parent

and offspring, can influence the child's development and partly explain variations in PTSD, including vulnerability or resilience.

Our study did not find any association between having an immigrant mother or two immigrant parents and being diagnosed with PTSD. A Danish register study showed an increased risk of anxiety disorders, including PTSD, among children who had an immigrant father or immigrant mother, but not among children who had two immigrant parents (Cantor-Graae and Pedersen, 2013). As mentioned earlier, immigrant women may be less severely traumatized than men. Immigrant women who are in relationships with Finnish men do not typically migrate from conflict areas and are more likely to come from Estonia, the former Soviet Union or South-East Asia (Statistics of Finland, 2018d). Moreover, women respond to stress differently than men, as they face a greater risk of depression and anxiety while men have a greater risk of aggressive behaviour and substance use (Chaplin, et al, 2008; Sadeh, et al, 2011; Verona and Kilmer, 2007). It is possible that the Finnish women with foreign-born partners in our study represented a select group with different traits to the general population and that could explain the association. Families with two immigrant parents may include refugee parents or others with traumatic experiences, but they may provide protective factors that decrease the risk of intergenerational traumatization.. There may also be resilience in the family that motivates immigrant parents to work hard so that they can provide a better life for their children (Hernandez, et al, 2012).

Some of our results may be explained by the possible underuse of health services and thus the under detection of PTSD in children with immigrant parents. Underuse of health services has been reported among immigrants in the Nordic countries and in the USA (Abebe, et al, 2017; Barghadouch, et al, 2016; Derr, 2016; Markkula, et al, 2018). A study by Schubert et al. (2019) in Finland reported mistrust in the health system, past traumatic experience, small social network and acculturation mediate the health seeking behavior for mental and somatic health services among immigrant families. In families with two immigrant parents, parents might not be as knowledgeable about their children's behavioral problems or be less likely to seek treatment for their behavior because of the fear of being stigmatized (Derivois, et al, 2013; Gary, 2005). The barriers that immigrant families experience such as language barriers and communication problems in accessing health services might increase the under diagnosis rates in immigrant children (Ahmed, et al, 2016). It is also possible that immigrant parents may use alternative

methods to treat mental health issues, in particular religious healing instead of Western practices (Mölsä, et al, 2017). However, Finnish mothers with a foreign-born partner are more likely to know the system well and may be more willing to use health services for their children than immigrant mothers. In addition to differences in service use, there may also be cultural differences in the reporting and representation of trauma. The low use of mental health services by immigrants, due to variations in cultural representation of trauma and the lack of cultural competence emphasizes the need to increase the responsiveness of mental healthcare systems to the needs of immigrants (Kortmann, 2010; Sarría-Santamera, et al, 2016).

The regional analysis showed that the children of immigrant fathers born in North Africa and the Middle East faced an increased risk of a PTSD diagnosis. Compared to most of the other geographical areas, many immigrants who come to Finland from these regions are refugees and are most likely to have experienced traumatic events (Castaneda, et al, 2017). Immigrants from this region have a higher risk of PTSD (Markkula, et al, 2017) and it is possible that their children travel back to their parents' home countries and are exposed to traumatic events or hear about the traumatic experiences of their parents and relatives.

We have showed that the timing of parental immigration had a relationship with the diagnosis of PTSD in children. Children whose fathers had migrated less than five years before their birth had a higher likelihood of being diagnosed with PTSD than children of fathers who had migrated more than five years ago. Recently migrated fathers might have had more memories of traumatic experiences affecting their daily functioning and the lives of their families. In addition, the parents may suffer more stress because they face a socio-economic disadvantage and they have to cope with the acculturation process and language barriers (Rask, et al, 2016). The accumulation of these factors has been shown to increase risk of child abuse (Rhee, et al, 2012; Schick, et al, 2016) which indicate the need for intervention and services among second-generation immigrants. Moreover, targeted policies should be developed to overcome barriers to access to health care such as improving health literacy for immigrants, use of interpreters, and cultural competence education for health professionals (Fernández-Gutiérrez, et al, 2018; Horvat, et al, 2014).

It is important to consider the limitations of this study. Even though it was based on a nationally representative sample, the findings may not be generalizable to other countries. First, our sample included a heterogeneous migrant group and the reason for their migration were unknown. Thus,

this study is not fully comparable to studies focusing on just refugees. Second, the sample only consisted of cases using specialized mental health services and this may have only included the severe cases. Less severe PTSD cases are not referred to specialized mental health services in Finland and are not recorded in national registers. Third, the registers did not record information on diagnoses in outpatient services before 1998. However, many children might have visited specialized services later and the diagnoses are included in the register. Fourth, the information on socio-economic status is limited and is less reliable among immigrants. Fifth, we could not control for confounders such as substance use and substance use disorder. Sixth, information on traumatic experiences of parents are not available in the registers. The final limitation was that the small sample of immigrants might give rise to type II errors.

## **Conclusion**

This national Finnish study showed an increased likelihood of diagnosis of PTSD among second-generation immigrants. The likelihood was higher for those with immigrant fathers born in North Africa and the Middle East and fathers who migrated less than five years before the birth of their child. The increased risk of PTSD among children born to immigrant fathers indicates possible intergenerational transmission of trauma in the offspring. These findings are important for clinical practice and research, as the number of immigrants coming to Finland is increasing. Our study underlines the need for psychosocial services to be provided to second-generation immigrant children. Schools and clinicians need to pay more attention to understanding the cultural contexts and behavioral problems of immigrant children. In addition, it is important that clinicians who treat traumatized immigrant parents are aware of the possible trauma transmission in their children.

## **Conflicts of interest**

None

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**Table 1** Covariates in relation to immigration status in controls and in relation to the risk of PTSD

Covariates	Immigration status				p-value <sup>a</sup>	Relationship between covariates and PTSD p-value <sup>a</sup>
	Both parents Finnish n (%)	Mother immigrant n (%)	Father immigrant n (%)	Both parents immigrants n (%)		
Maternal age					0.0115	<0.001
Maternal age (<median, 29)	6898 (49.4)	67 (49.6)	82 (40.6)	81 (58.7)		
Maternal age (≥median, 29)	7061(50.6)	68 (50.4)	120 (59.4)	57 (41.3)		
Paternal age <sup>b</sup>					<0.001	<0.001
Paternal age (<median, 31)	6787 (49.1)	36 (26.7)	104 (51.5)	62 (44.9)		
Paternal age (≥median, 31)	7033 (50.9)	99 (73.3)	98 (48.5)	76 (55.1)		
Maternal psychiatric disorders					0.072	<0.001
Yes	1878 (13.5)	16 (11.8)	39 (19.3)	15 (10.9)		
No	12081 (86.5)	119 (88.2)	163 (80.7)	123 (89.1)		
Paternal psychiatric disorders <sup>c</sup>					0.056	<0.001
Yes	1902 (13.8)	26 (19.3)	21 (10.4)	13 (9.4)		
No	11918 (86.2)	109 (80.7)	181 (89.6)	125 (90.6)		
Number of previous birth <sup>d</sup>					0.123	0.207
Previous births = 0	5556 (40.2)	53 (42.1)	93 (48.2)	51 (37.2)		
Previous births ≥ 1	8274 (59.8)	73 (57.9)	100 (51.8)	86 (62.8)		
Maternal Marital status <sup>e</sup>					0.0044	<0.001
Married/ in a relationship	12742 (98.1)	125 (100)	163 (94.2)	127 (98.5)		
Single	242 (1.9)	0 (0)	10 (5.8)	2 (1.5)		

**Table 1** (continued)

Covariates	Immigration status				Relationship between covariates and PTSD	
	Both parents Finnish n (%)	Mother immigrant n (%)	Father immigrant n (%)	Both parents immigrants n (%)	p-value	p-value
Maternal socio-economic status					<0.001	<0.001
Upper white-collar workers	1473 (10.6)	28 (20.7)	28 (13.9)	12 (8.7)		
Lower white-collar workers	4739 (33.9)	25 (18.5)	63 (31.2)	14 (10.1)		
Blue collar workers	1889 (13.5)	23 (17.0)	28 (13.9)	18 (13.0)		
Other	1490 (10.7)	27 (20.0)	36 (17.8)	61 (44.2)		
Unknown	4368 (31.3)	32 (23.7)	47 (23.3)	33 (23.9)		

<sup>a</sup>Pearson's  $\chi^2$  test. Frequency missing: <sup>b</sup>89 cases (2.5%), 139 controls (0.9%); <sup>c</sup>89 cases (2.5%), 139 controls (0.9%); <sup>d</sup>39 cases (1.1%), 148 controls (1.03%); <sup>e</sup>359 cases (9.9%), 1023 controls (7.1%).

**Table 2** Parental immigration status by PTSD in cases and controls

Immigration status	Cases n (%)	Control n (%)	Unadjusted Odds ratio (95% CI)	<sup>a</sup> Adjusted Odds ratio (95 % CI)
Both parents Finnish	3483 (95.7)	13959 (96.7)	Ref	Ref
Both parents immigrants	32 (0.9)	138 (0.9)	0.9 (0.6 - 1.4)	0.9 (0.6 -1.6)
Father immigrant	84 (2.3)	202 (1.4)	1.7 (1.3 - 2.2) ***	1.8 (1.3 - 2.4) ***
Mother immigrant	40 (1.1)	135 (0.9)	1.2 (0.8 - 1.7)	1.1 (0.8 - 1.7)

CI, confidence interval.

<sup>a</sup> Adjusted for maternal age, paternal age, parental psychiatric history, marital status and maternal socio-economic status.

\*\*\*  $p \leq 0.001$

**Table 3** Timing of paternal immigration by PTSD in cases and controls

	Cases n (%)	Controls n (%)	Unadjusted Odds ratio (95% CI)	<sup>a</sup> Adjusted Odds ratio (95 % CI)
Finnish	3437 (96.9)	13957 (97.7)	Ref	Ref
Immigration at least 5 years before birth	34 (0.9)	143 (1.01)	1.01 (0.7 - 1.5)	1.3 (0.8 - 1.9)
Immigration less than 5 years before birth	73 (2.1)	184 (1.3)	1.6 (1.2 - 2.1) ***	1.4 (1.03 - 1.9) **

CI, confidence interval.

<sup>a</sup> Adjusted for maternal age, paternal age, parental psychiatric history, marital status and maternal socio-economic status.

\*\* p ≤ 0.01, \*\*\* p ≤ 0.001

<sup>b</sup>Frequency missing: 95 cases (2.6%), 150 controls (1.04%).



**Table 4** Maternal and paternal region of birth in cases and control, based on geographical categorization of their countries of origin

Region of birth	Case n (%)	Control n (%)	Unadjusted Odds ratio (95% CI)	<sup>a</sup> Adjusted Odds ratio (95 % CI)
<b>Mothers</b>				
Finland	3513 (96.5)	14002 (97.01)	Ref	Ref
Asia	13 (0.4)	51 (0.4)	1.1 (0.6-1.9)	1.1 (0.6-2.2)
Europe + North America+ Australia	56 (1.5)	179 (1.2)	1.3 (0.9-1.7)	1.1 (0.7-1.5)
North Africa+ Middle East	11 (0.3)	30 (0.2)	1.5 (0.7-2.9)	1.1 (0.5-2.5)
Russia + Former Soviet Union or Yugoslavia	38 (1.0)	127 (0.9)	1.2 (0.8-1.7)	1.2 (0.8-1.3)
Sub-Saharan Africa	5 (0.1)	37 (0.3)	0.6 (0.2-1.4)	0.6 (0.2-1.6)
<b>Fathers<sup>b</sup></b>				
Finland	3392 (95.6)	13820 (96.7)	Ref	Ref
Asia	6 (0.2)	38 (0.3)	0.7 (0.3-1.6)	0.8 (0.3-1.9)
Europe + North America+ Australia	66 (1.9)	231 (1.6)	1.2 (0.9-1.6)	1.02 (0.7-1.4)
North Africa+ Middle East	45 (1.3)	80 (0.6)	2.3 (1.6-3.4) ***	2.1 (1.4-3.3) **
Russia + Former Soviet Union or Yugoslavia	20 (0.6)	60 (0.4)	1.4 (0.8-2.3)	1.4 (0.7-2.5)
Sub-Saharan Africa	16 (0.5)	53 (0.4)	1.2 (0.7-2.2)	1.4 (0.7-2.6)

CI, confidence interval.

<sup>a</sup> Adjusted for maternal age, paternal age, parental psychiatric history, marital status and maternal socio-economic status.

\*\*  $p \leq 0.01$ , \*\*\*  $p \leq 0.001$

<sup>b</sup>Frequency missing: 94 cases (2.6%), 152 controls (1.1%).