



Increased risk of suicidal behaviour in non-European international adoptees decreases with age - A Swedish national cohort study

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ABSTRACT

Background: Non-European international adoptees in Sweden were shown to have a three- to fourfold higher risk of suicidal behaviour in youth during 1986–1995 compared with the general population. The aim of this study was to investigate whether this high risk persists beyond youth and in later cohorts.

Methods: A register study of Swedish national cohorts born 1972–86 including 20 625 non-European international adoptees, and comparison populations of 10 915 non-European immigrants and 1 435 167 Swedish born was performed. The study population was followed from age 18 between 1991 and 2016, with suicide and hospital admissions due to suicide attempt as outcomes. Poisson regression models of person time in the study, adjusted for gender and household income at age 17, were fitted to calculate relative risks (RR).

Findings: Adjusted RR for suicide in non-European international adoptees was high at age 18–22, 2.74 (95% C.I. 1.95–3.86), but decreased gradually to age 33–43 when the risk was similar to Swedish-born. Adjusted RR for suicide attempts in international adoptees was 2.33 (2.15–2.52) at age 18–22, decreased slightly with older age, but remained higher than Swedish born in all age-classes. Risks for both outcomes were greatest, around three times higher compared with the Swedish-born in the oldest birth cohorts of non-European international adoptees, born 1972–76. Risks for both suicidal outcomes increased with higher age at adoption.

Interpretation: The risk of suicidal behaviour in non-European international adoptees in Sweden decreases with age and is lower in later birth cohorts and in infant adoptions.

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1. Introduction

In 2002, we reported in *The Lancet* that non-European international adoptees in Sweden, compared to same-age peers, ran a three- to fourfold increased risk for suicide and suicide attempt in youth [1]. The higher risk of suicidal behaviours amongst adoptees occurred in the context of severe psychosocial problems, like criminality and substance abuse, as well as mental ill-health. All these findings evoked considerable concern about the situation of non-European international adoptees in Sweden. In subsequent studies, we confirmed these high risks of suicide [2–5] and suicide attempts [4,5] amongst non-European international adoptees in cohorts from the 1960's and 1970's.

Non-European international adoptees are exposed to a number of specific distal, mediational and proximal risk factors for suicidal behaviour and psychiatric disorders to a higher degree than non-adopted peers [6]. Regarding distal risk factors, which confer vulnerability for negative outcomes, genetic influences alone [7,8] or in interaction with other risk factors, such as adoptive mother's psychiatric hospitalization [9], have been reported to increase the risk of suicide amongst national adoptees. Another significant distal risk factor amongst adoptees is early adversity, such as childhood maltreatment and institutionalization, with a longer duration of such exposure linked to poorer outcomes [10,11]. Death rates from all causes, including suicide, have been found to be higher with increasing age at adoption placement [8]. Mediator or moderator risk factors, that fully or partially explain the relationship between predictors and outcomes [12], may include both stable problems such as deficient executive functioning, e.g. in the presence of ADHD [11,13] and cognitive impairment, [11,14] but also transient developmental traits. For

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Research in context

Evidence before this study

Previous research has documented a higher incidence of suicidal behaviour - comprising suicide deaths and suicide attempts - in non-European international adoptees at the ages 16–25 years in the context of increased risk for behavioural, social and psychiatric problems. Early childhood adversity is a well-established risk factor for behavioural and emotional problems in childhood and young adulthood, with a longer exposure linked to more serious and persistent difficulties. Age at adoption may be seen as a marker of duration of such experiences.

Added value of this study

Higher age at adoption was associated with increased risks for both suicidal outcomes in non-European international adoptees. The risk of suicide found in youth in previous studies decreased with age and was similar to the general Swedish population beyond 32 years of age. The risk of suicide attempt also decreased with age, but remained higher than the comparison groups beyond 32 years. The risk of suicide up to age 30 decreased considerably in the birth cohorts 1977–1986 compared with the non-European adoptees born 1972–1976, while the risk for suicide attempt only decreased slightly.

Implications of all available evidence

Non-European international adoptees are at particular risk for suicidal behaviour in youth, probably due to enhanced identity problems. The decreasing risk of suicide with age and over the decades in non-European international adoptees suggests that some of their difficulties may be transient and can be addressed socially and professionally. Postadoption clinical services are particularly important for late adoptees and in the transition from childhood to adulthood.

and suicidal behaviour in non-European international adoptees have increased the awareness, both amongst professionals and non-professionals, about their higher suicide risk. This may in turn have led to an increased alertness to suicidal signals in adoptees, which may be beneficial from a suicide prevention perspective. Contrarily, the attention in Swedish media about the relation between adoption and suicide might have had a stigmatizing effect. Moreover, we feared that the results might induce so-called suicide contagion [20]. It is well-known that media reports about specific suicides may inspire other individuals to commit suicide [21]. Further, the spectrum of risk factors may have changed over time, contributing to cohort effects.

Non-European international adoptees as children are easily recognizable in the Swedish context since their physical appearance in most cases is clearly different from the vast majority of their Swedish adoptive parents. Non-European immigrants with similar physical appearance constitute an interesting comparison group. In terms of suicidal behaviour, immigrants in the Nordic countries tend to have suicide rates which are similar to the rates in their countries of origin [2,22]. Further, socioeconomic hardship shared by immigrants with different origin background has been associated with increased risk for self-inflicted injuries/suicide attempt in Sweden [23].

Thus, the main aim of this study was to investigate the influence of age and time, operationalised as birth cohort, on suicidal behaviour in non-European international adoptees. A second aim was to investigate the impact of preadoption adversity on suicidal behaviour, using age at adoption as a proxy indicator.

2. Methods

This study is based on information from the Swedish national registers, containing data with high validity and low attrition rates [24]. These registers are based on the unique personal identity number assigned to all Swedish residents at birth (or time of immigration), and data from different registers can be linked by use of these identity numbers.

The linkage for this study was made by Statistics Sweden, a national state-funded government agency that produces official statistics and prepares register data for researchers. Before the data was handed over to Professor Hjern, it was anonymized by replacing the personal IDs with random numbers and re-categorizing key variables into broad categories. Because of the anonymisation and the large study population, obtaining informed consent was not possible. However, Swedish legislation makes it possible to access anonymized data from national registers for research under certain conditions, one being the approval of an approved ethics committee. This study was approved by the Regional ethics committee in Stockholm region (No. 2014/415–31/5).

The study population was comprised of individuals born 1972–1986 who, according to the Register of the Total Population [25], were alive and resident in Sweden on their 18th birthday. They were followed from their 18th birthday until 2016, when they were in the ages of 30–44 years. Biological and/or adoptive parents of these individuals were identified in the Multi-Generation Register [26]. Age at immigration/adoption and information on country of birth was retrieved from the Register of the Total Population. Based on this information we created three study groups. *Non-European international adoptees* ($N = 20\ 625$) fulfilled the criteria of being born in the East Asia, the Indian subcontinent, East Africa or Latin America and having at least one Swedish-born adoptive parent but non-identified birth parents, and having entered Sweden before their ninth birthday. *Non-European immigrants* ($N = 10\ 915$) were born in the same regions as the international adoptees and had settled in Sweden before their ninth birthday, had at least one identified birth parent and no adoptive parent in the Multi-Generation Register; and the *Swedish-born* ($N = 1\ 435\ 167$) in the same birth cohorts.

adoptees, thwarted belongingness, one of the mediational risk factors for suicidal behaviour identified by van Orden et al., [15] might be particularly relevant during adolescence and emerging adulthood in the context of a more complex identity development [16]. This is particularly relevant in the case of international adoptees, as their identity formation involves the so-called “transracial adoption paradox”, whereby adoptees who are racial/ethnic minorities are perceived and treated as if they are members of the majority culture [17]. Finally, proximal risk factors that trigger or precipitate outcomes [12], including emerging psychopathology and substance abuse, are overrepresented amongst non-European international adoptees, as shown in our *Lancet* study. ¹Considering suicidal thoughts, suicidal attempts and actual death by suicide as an itinerary of severity [18], the risk factor burden increases, from fewer facets of risk in ideation, more numerous risk factors in suicide attempts and even more in deaths by suicide [15].

Close to two decades have soon passed since our first study on non-European international adoptees was published, and the first cohorts of non-European international adoptees in Sweden have reached their 40's, allowing us to raise new research questions regarding suicidal behaviour. Firstly, the study population in our first article was young; 16–25 years, and it thus seems important to investigate whether the higher risk of suicidal behaviour was a youth phenomenon or an indication of a life-long vulnerability. Secondly, over time much experience and knowledge has been gained about international adoption [19] and reports of mental health problems

Table 1
Sociodemographic characteristics of the study population.

	Swedish-born N = 1,435,167	International adoptees N = 20,625	Immigrants N = 10,915
	N(%)	N(%)	N(%)
Gender			
Men	736,925(51.3)	8823(42.8)	5565(51.0)
Women	698,242(48.7)	11,802(57.2)	5350(49.0)
Year of birth			
1972–76	513,055(35.7)	6591(32.0)	2898(26.6)
1977–81	458,078(31.9)	7123(34.5)	3115(28.5)
1982–86	464,034(32.3)	6911(33.5)	4902(44.9)
Disposable household income			
Low			
Quintile 1	247,004(17.1)	2052(10.0)	4683 (42.9)
Quintile 2	289,071(20.2)	2773(13.5)	2829(25.9)
Quintile 3	297,432(20.7)	3765(18.3)	1693(15.5)
Quintile 4	300,772(21.0)	5056(24.6)	1032(9.5)
High			
Quintile 5	300,899(21.0)	6929(33.7)	678 (6.2)

2.1. Outcomes

Suicide was defined as having an underlying cause of death in the Causes of Death Register [27] coded according to the International Classification of Diseases (ICD) as suicide (ICD-9: E950-E959; ICD-10: X60-X84) or as a self-inflicted death with uncertain intent (ICD-9: E980-E989; ICD-10: Y10-Y34). Similarly, we used the same codes to define suicide attempt/self-inflicted injury in e-codes in the Patient Discharge Register [28]. With our broad definition of suicide, including deaths with uncertain intent, our aim was to minimize spatial and secular trends in detecting and classifying cases of suicide [29]. In Sweden, the intent in suicide deaths is judged by forensic specialists after autopsy [27], while the suicide intent in hospitalised self-inflicted injuries is judged by the responsible hospital physician [28].

2.1.1. Socio-economic covariates

Gender and disposable household income were retrieved from the Longitudinal Integration Database for Health Insurance and Labour Market Studies in the year of the 17th birthday. Disposable household income was calculated by Statistics Sweden with an algorithm that includes all taxable income in the household deducted by paid taxes and divided by consumer units, and divided into quintiles by annual birth cohort of the entire study population.

2.2. Statistical analysis

Since the basic assumption for Cox regression was not met, we used the Poisson distribution in a General Linear Model with person time as an offset to calculate Relative Risks (RR) of the two outcomes per person time unit with 95% confidence intervals (95%CI). Person

time in the study is the time an individual is followed up in the national registers. In this study it was calculated from age 18 to the date of the outcome, or if no outcome was recorded, to the end of the study on 31st of December 2016. Statistical analysis was conducted using SPSS (IBM SPSS Statistics version 25.0, [SPSS, Inc., IBM Corp., Armonk, NY, USA]).

Interaction analyses could not detect significant gender differences for any of the two outcomes, and thus all regression analyses were made with men and women together. Models analysing change over age in five year classes were adjusted for gender, birth cohort and household disposable income in quintiles. Models analysing change over birth cohorts categorised year of birth in three categories; 1972–1976, 1977–1981 and 1982–1986 and were adjusted for gender, and household disposable income in quintiles.

In the analyses of age at adoption, this age was operationalised into four categories representing the exposure to adversity at ages with clear developmental significance and based on the distribution of this variable in the population of non-European international adoptees: 0 year, 1 year, 2–3 years and 4–8 years, based on the distribution of this variable in the population of non-European international adoptees. In a multivariate analysis, the non-European international adoptee study group was divided into four categories based on this indicator and analysed in three consecutive Poisson regression models. Model 1 was adjusted for gender, Model 2 added year of birth in the three categories defined above and Model 3 added household disposable income in quintiles.

2.3. Role of funding source

No specific funding was obtained for this study.

3. Results

Table 1 describes the socio-demographic characteristics of the study population. The non-European international adoptees had a skewed gender distribution with 57.2% women, while gender was more evenly distributed in the two comparison populations. The households of the non-European international adoptees more often had incomes in the highest quintiles, while the opposite was true for the immigrants.

The study population contributed a mean person time of 20.1 years per person to the study, with marginal variation between the study groups (Table 2). The overall incidence of suicide in the total study population was 1.5/10 000 person years, with men having an incidence of 2.2/10 000 person years and women 0.8/10 000. The overall incidence of having a first hospital admission because of suicide attempt was 12.0/10 000 person years, with 9.3/10 000 person years in men and 15.0/10 000 person years in women. There was a

Table 2
Incidence of suicide and suicide attempts by covariates.

	N	Mean person years in the study	Suicide		Suicide attempt	
			Cases	1/10,000	Cases	1/10,000
Study groups						
International adoptees	20,625	19.7	103	2.5	1137	28.0
Immigrants	10,915	18.9	44	2.1	389	18.9
Swedish-born	1,435,167	20.1	4376	1.5	33,886	11.8
Gender						
Men	751,313	20.0	3347	2.2	14,169	9.3
Women	715,394	20.1	1210	0.8	21,681	15.0
Household income						
Low						
Quintile 1	253,788	20.2	1027	1.9	9434	17.9
Quintile 2	294,671	20.1	1016	1.7	8271	13.9
Quintile 3	302,899	20.0	953	1.6	6912	11.3
Quintile 4	306,855	20.1	844	1.4	6057	9.8
High						
Quintile 5	308,504	20.0	715	1.2	5176	8.4

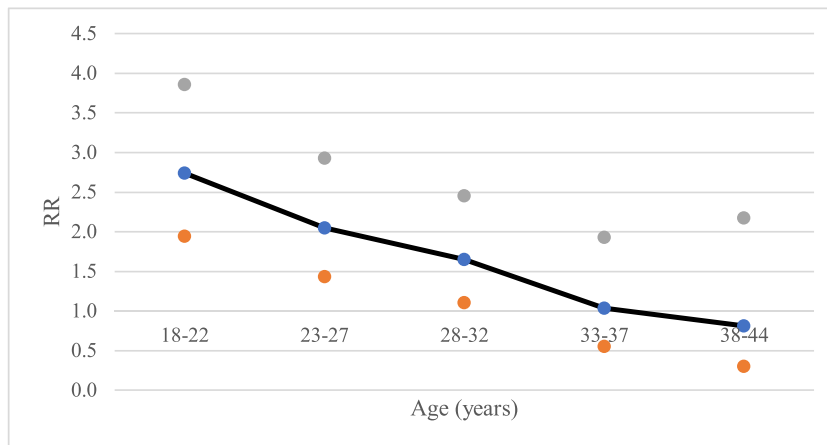


Fig. 1. Relative risks with 95% CI of suicide in non-European international adoptees in five-year classes from age 18 years to 44 years compared with the Swedish-born population. Adjusted for gender and disposable household income at age 17.

clear social gradient for both outcomes with a lower household income at age 17 being associated with a higher incidence of suicide and suicide attempt (Table 2).

As Table 2 demonstrates, non-European international adoptees had the highest incidence of suicide with 2.6/10 000 person years, migrants 2.1 /10 000 person years and the Swedish-born population 1.5/10 000. The percentage of suicides categorised as having a clear suicide intent was 87% for the non-European international adoptees, 79.5% for the immigrants and 74.9% in the Swedish-born. During the entire study period from 1991 to 2016, the fully adjusted RRs of suicide was 1.95 (95%CI 1.60–2.37) in non-European international adoptees and 1.22 (95%CI 0.90–1.64) in the immigrants compared with the Swedish-born population.

The percentage of suicide attempts categorised as having a clear intent was similar in the three study groups; 32.5%–32.9%. For suicide attempt, the fully adjusted RRs were 2.47 (95%CI 2.33–2.62) for non-European international adoptees and 1.23 (95%CI 1.11–1.36) for the immigrant group.

3.1. Suicidal behaviour by age

In a longitudinal study like this one, the mean age of the population increases gradually over time. Figs. 1 and 2 demonstrate adjusted relative risks of suicide and suicide attempts in the non-European

international adoptees in five-year classes from age 18 onwards, with the Swedish-born population as reference group. The RR for suicide in non-European international adoptees was high at age 18–22, 2.74 (95% C.I. 1.95–3.86), but then decreased gradually to RR 2.05 (95% C.I. 1.44–2.93) at age 23–27 years, 1.65 (95% C.I. 1.11–2.45) at age 28–32 and was similar to the Swedish-born population at age 33–43 (Fig. 1). For suicide attempt the RRs also decreased somewhat with older age, but remained higher than the Swedish-born population in all age classes (see Fig. 2). For the immigrant population, no clear patterns were seen regarding age (See Supplemental figures S1 and S2).

3.2. Suicidal behaviour by birth cohort

This study includes 15 yearly birth cohorts. In an analysis of the variation of suicidal behaviour by year of birth, the study population was divided into three year of birth categories; 1972–76, 1977–81 and 1982–86. Suicide and suicide attempt were studied in the age-group 18–30 years, so that the follow-up time was the same for the three cohorts. In the case of suicide, the RR of non-European international adoptees in comparison with the Swedish-born population, after adjustment for gender and household income, was considerably higher in the 1972–76 cohort, RR 3.38 (95%CI 2.39–4.79) than in the 1977–81 cohort, RR 1.87 (95%CI 1.21–2.57), and 1982–86 cohort,

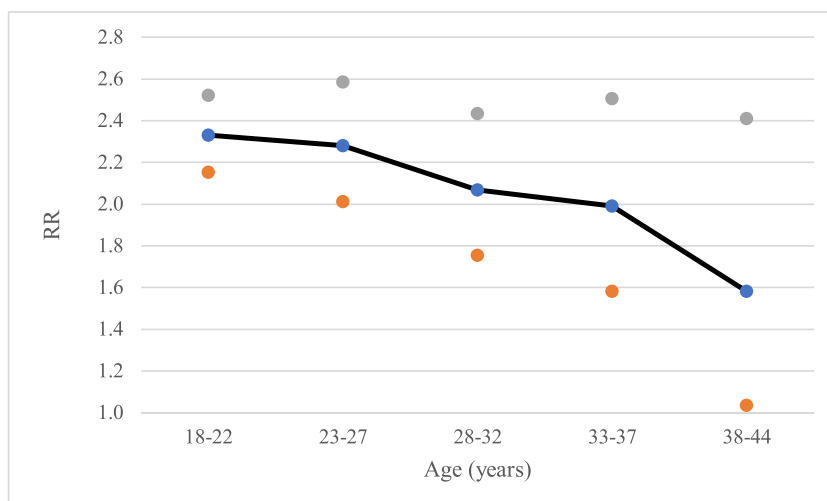


Fig. 2. Relative Risk with 95% CI for first hospital admissions because of suicide attempts in non-European international adoptees in five year classes from age 18 years to 44 years compared with the Swedish-born population. Adjusted for gender and disposable household income at age 17.

Table 3
Incidence and Relative risk (RR) of suicide from age 18 to 30 years by year of birth.

	Adoptees	Immigrants	Swedish-born
N			
1972–76	6591	2898	513,055
1977–81	7123	3115	458,078
1982–86	6911	4902	464,034
Cases			
1972–76	33	5	885
1977–81	21	10	854
1982–86	26	21	1030
1/10,000			
1972–76	3.9	1.3	1.3
1977–81	2.3	2.5	1.4
1982–86	2.9	3.3	1.7
RR (95% CI)			
1972–76	3.38 (2.39–4.79)	0.89 (0.37–2.16)	1
1977–81	1.87 (1.21–2.57)	1.56 (0.84–2.92)	1
1982–86	1.97 (1.34–2.92)	1.63 (1.05–2.51)	1

Table 4
Incidence and Relative risk of suicide attempts from age 18 to 30 years by year of birth.

	Adoptees	Migrants	Swedish-born
N			
1972–76	6591	2898	513,055
1977–81	7123	3115	458,078
1982–86	6911	4902	464,034
Cases			
1972–76	289	73	7665
1977–81	348	107	9474
1982–86	364	154	11,260
1/1000			
1972–76	33.9	19.5	11.5
1977–81	37.7	26.5	16.0
1982–86	40.7	24.3	18.7
RR (95% CI)			
1972–76	2.86 (1.41–3.23)	1.41 (1.12–1.78)	1
1977–81	2.48 (2.23–2.76)	1.36 (1.13–1.67)	1
1982–86	2.41 (2.17–2.67)	1.05 (0.90–1.23)	1

RR 1.97 (95%CI 1.34–2.92). In contrast, the RRs in the immigrant population tended to increase in the later birth cohorts (Table 3).

In comparison with the Swedish-born population, the adjusted RRs for suicide attempts decreased slightly over time for the non-European international adoptees from 2.86 (95%CI 2.41–3.23) in the 1972–76 cohort to 2.41 (95%CI 2.17–2.67) in the 1982–86 cohort. A decrease in the adjusted RRs in later year of birth cohorts was noted also for the immigrants; from 1.41 (95%CI 1.12–1.78) in the 1972–76 cohort to 1.05 (95%CI 0.90–1.23) in the 1982–86 cohort (Table 4).

3.3. Age at adoption

The RRs of suicide and suicide attempt associated with age at adoption are presented in Table 5. The RR for suicide for non-European adoptees adopted before their first birthday was similar to Swedish-born and the immigrant study group, and increased gradually with higher age at adoption to 2.37 (95%CI 1.95–2.79) in adoptees adopted at age 4–8.

The RR for suicide attempt for non-European adoptees adopted before their first birthday was considerably higher than Swedish-born with RR 1.76 (95%CI 1.66–1.87) in the fully adjusted model and higher also than the immigrant study group; RR 1.20 (95%CI 1.11–1.31) and gradually increased with increasing age at adoption to 2.37 (95%CI 2.22–2.52). Adjusting for disposable household income attenuated estimates for both suicide and suicide attempt in the immigrant study group compared with Swedish-born, from 1.34 (95%CI 1.04–1.64) to 1.20 (95%CI 0.89–1.49) for suicide and from 1.47 (95%CI 1.37–1.57) to 1.20 (95%CI 1.11–1.31) for suicide attempt, while estimates for the Non-European international adoptees increased slightly with this adjustment.

4. Discussion

In this register-based study of suicidal behaviour in non-European international adoptees in Sweden, we found that risks of suicide and suicide attempt in non-European international adoptees decreased in middle age (beyond 32 years of age) and increased gradually by age at adoption, being lowest for those adopted during their first year of life. Risks for both suicide outcomes were around three times higher compared with the Swedish-born population amongst non-European international adoptees born 1972–76 at age 18–30, on par with our previous *Lancet* study in the cohorts born 1970–77, but considerably lower in the cohorts born 1977–1986.

The increased risks of both suicides and attempts amongst adopted persons probably reflect an accumulation of distal, mediational and

proximal risk factors [12]. Confirming previous research [30], the increased risks associated with age at adoption points to the importance of distal factors related to early adversity. A higher incidence of problems with increased adoption age has been reported previously in the case of executive functioning [31], IQ, [14,11] anti-social behaviour [1] and psychotic disorders [32]. The longitudinal English Romanian Adoptees study [11] has shown an onset of emotional problems in youth that continues into young adulthood in children exposed to a deprived institutional environment for more than 6 months, suggesting a link between depressive symptoms in youth and early adversity in non-European international adoptees.

If suicidal deaths involve a higher burden of risk factors [18], a decreasing incidence in adulthood seems to indicate that the influence of distal factors on depression relative to other mediational and proximal factors decreases over time. The higher risk of suicidal behaviour in youth may be influenced by adoption specific factors during this phase of the life course [33,34].

One such factor is thwarted belongingness in the process of developing an adoption-related identity [11,16]. Non-European international adoptees need to deal with a double set of parents and with having their origins in another continent. They do not share genetically determined traits and outlooks with their parents. Many have an appearance which is different from most other inhabitants in the receiving country. Difficulties to form a personal identity has since long been regarded as a major developmental challenge for non-European international adoptees and identity problems have typically been suggested as one of the underlying factors for the increased risk of mental ill-health in this group [16]. In a Swedish study, Cederblad et al. [35] found associations between identity problems and psychiatric symptoms, as well as low self-esteem. The lower risk for suicidal behaviour with increasing age provides tentative support for the hypothesis that identity problems, most prevalent during adolescence and early adulthood, may constitute a mediational risk factor for suicide specifically during these phases.

The risk for suicidal behaviour decreased in the birth cohorts born 1977–1986 in the non-European international adoptees compared with those born 1972–1976. Post-adoption factors, including better adoption support practices [19], may underlie the cohort effect. For instance, during the start of this millennium, adult non-European international adoptees had initiated a critical public debate on international adoption – the first of its kind in a Swedish setting [36]. Also, our previous *Lancet* article [3] was given ample attention by Swedish media [37]. This debate led to the introduction of a compulsory education for parents before adoption [38], but did not lead to any major changes in national policy regarding support to non-European international adoptees as young adults.

Table 5
Age at adoption and RRs with 95% CI of suicide and suicide attempt.

	N	Suicide			Suicide attempt		
		Model 1 ¹ RR (95% CI)	Model 2 ² RR (95% CI)	Model 3 ³ RR (95% CI)	Model 1 ¹ RR (95% CI)	Model 2 ² RR (95% CI)	Model 3 ³ RR (95% CI)
International adoptees							
Age at adoption							
0 year	8675	1.09 (0.71–1.47)	1.08 (0.67–1.47)	1.16 (0.68–1.55)	1.68 (1.58–1.79)	1.64 (1.54–1.75)	1.76 (1.66–1.87)
1 year	7196	1.48 (1.15–1.82)	1.48 (1.15–1.81)	1.55 (1.22–1.88)	1.76 (1.66–1.87)	1.75 (1.64–1.85)	1.85 (1.75–1.96)
2–3 years	2883	1.71 (1.25–2.17)	1.71 (1.25–2.18)	1.77 (1.30–2.24)	2.17 (2.03–2.30)	2.27 (2.03–2.30)	2.25 (2.12–2.39)
4–8 years	1871	2.32 (1.90–2.74)	2.33 (1.92–2.75)	2.37 (1.95–2.79)	2.28(2.13–2.44)	2.32(2.16–2.47)	2.37(2.22–2.52)
Immigrants	10,915	1.34 (1.04–1.64)	1.32 (1.02–1.62)	1.20 (0.89–1.49)	1.47(1.37–1.57)	1.40(1.30–1.50)	1.20(1.11–1.31)
Swedish-born	1,435,159	1	1	1	1	1	1

¹ Model 1 is adjusted for gender.

² Model 2 is adjusted for gender and year of birth in three categories.

³ Model 2 is adjusted for gender, year of birth in three categories and disposable income in quintiles.

As stated above, we reported a three-fold increased risk for hospitalisation due to a psychiatric disorder in our previous study of suicide in non-European international adoptees [3]. Information about this finding was widely spread amongst Swedish professionals and laymen at that time. Hypothetically, this may have led to an increased awareness about mental health problems in adoptees and an improved capacity to identify and respond to a psychiatric diagnosis in this group. If so, this could have been an important suicide prevention measure. A mental disorder is common in suicide and occurs in more than 90% of all cases [39]. At the other end of the suicidal behaviour spectrum suicide gestures (self-injury without intention to die), the influence of mental disorder is less important [40]. Thus, if improved identification of a psychiatric disorder is one explanation of the decrease of suicidal behaviour over time in the adoptees, this could explain why the change over time for suicides was more impressive than for suicide attempts. It was not possible to study the role of psychiatric disorders in our present study design, but is certainly an important focus for future studies.

The immigrant population in this study had increased risks of both suicide and suicide attempt compared with the same age peers in the Swedish-born population on par with the non-European international adoptees who were adopted as infants, but these risks were lower than the risk of the non-European international adoptees, perhaps reflecting less exposure to adversity in early childhood, and did not decrease with increasing age. For the immigrants, the risks in this study are similar to those reported in previous Swedish studies of suicide [22] and suicide attempt [23]. In contrast to the non-European international adoptees, these risks decreased substantially when the disposable income of the household at age 17 was accounted for, suggesting that some of these increased risks were associated with socio-economic factors in Sweden.

The main strength of this study is the combination of a large population of non-European international adoptees with minimal attrition and the high-quality information available on suicide outcomes for 25 years in the Swedish national registers, including a high autopsy rate in deaths outside of hospitals [27]. The main limitation is the scarcity of information about the pre-adoption circumstances of the adoptees. Age at adoption was used as a proxy indicator of childhood adversity in this study. It is possible that selection factors are also involved, for example that children with more health and behavioural problems tend to be adopted at a later age [41]. Finally, the study was not powered to look at gender aspects of the main research questions about change over time and the impact of early adversity.

As suggested by Linsley et al. [29], a broad definition of suicidal behaviour was used, to minimise the impact of variations over time and place in the distinction of clear and unclear intent of suicide and over time and place, including cases judged to have a clear suicidal intent as well as those with an unclear intent. Considering that the percentage of clear intent in suicides was higher in the non-European

adoptees than in the other study groups, it seems probable that analysing cases with clear intent only would have yielded higher effect estimates for this study group.

This study demonstrates that the higher risk of suicide found in previous studies of non-European international adoptees in Sweden primarily is a youth phenomenon that decreases gradually with age and is similar to the general population after age 30 years. Risks for suicide attempts, however, remain high. Decreasing risks of suicide behaviour in later birth cohorts suggests that changes for the better have occurred with regards to international adoption in Sweden in more recent years. Better outcomes for those adopted at earlier ages align with adoption research findings in other domains.

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Author contributions

AH initiated this study, created the dataset from multiple register sources and wrote the first draft of the article with FL. AH designed the study and analysed the data with HM. All authors interpreted the results, revised the manuscript and have approved the final version.

Data sharing statement

The Swedish legislation around access to register data for research purposes does not allow sharing this data with third parties. To access similar data as that used in this study, the researcher has to make a personal application to the register-holding agencies.

Declaration of Competing Interest

Frank Lindblad is the adoptive father of two international adoptees. All other authors have nothing to declare.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2020.100643.

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