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ORIGINAL ARTICLE

Comparison of the health of Roma and non-Roma children living in the district of Teplice

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Abstract
Objectives To compare the morbidity of 66 Roma and 466 non-Roma children born and living in a diffused type of habitation in the district of Teplice.
Methods For each child, a complete list of illnesses that pediatricians recorded using ICD-10 codes for all physician visits and/or hospitalizations was obtained.
Results At the age 0–2 years the Roma/non-Roma rate ratios (RR) of the incidence of influenza (RR 1.6), otitis media (RR 2.3), intestinal infectious diseases (RR 1.7) and viral illnesses (RR 6.3) were statistically associated with ethnicity. The higher incidence of bronchitis (RR 1.7) and pneumonia (RR 2.2) in the Roma children was associated with the low education of mothers and not with ethnicity.
Conclusions At the age of 0–2 years the incidence of influenza, otitis media, intestinal infectious diseases and of viral diseases was significantly higher in Roma than in non-Roma children and was not associated with education of mothers. There was no increase in the morbidity of Roma children over the non-Roma children at the age of 2–6 years. The prevalence of allergies in Roma children was extremely low.

Keywords Roma children · Health · Morbidity · Allergy · Maternal education

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Introduction

It has repeatedly been stated that data on the health of Roma children are extremely scarce. Hajioff and McKee (2000) reviewed the published literature on Roma health. Seventy percent of publications (73 papers) were from just four countries: Spain, Czech Republic, Slovakia and Hungary. They found 34 papers related to child health and stated that there was little research on the common disorders of childhood. According to the review, other research is eclectic; a lower incidence of childhood brain tumors and higher incidence of lead poisoning and burns in Roma children were mentioned as examples (for literature see Hajioff and McKee 2000). Subsequently, the situation has not changed much. Among the data published, those on reproductive outcomes and neonatal mortality rate prevail. Ginter et al. (2001) published a report on the health status of Roma in Slovakia, based on papers published mostly in Czech or Slovak. As far as children are concerned, Roma preschool age children were lighter, had lower head and chest circumference, lower depth of the chest, and manifested trends to lower thyroxine levels. The results were similar with school-age children. The probability of recessive genetic diseases was increased due to a high coefficient of inbreeding of the parents. There were reports of a higher incidence of congenital anomalies, glaucoma and phenylketonuria. In East Slovakia there was a significantly higher incidence of congenital hypothyroidism. Roma children had a generally higher prevalence of infectious diseases, parasitic diseases, hospitalizations, poisonings, injuries and burn. Kanapeckiene et al. (2009) used an anonymous questionnaire with volunteer Roma children in two Roma schools: one in Vilnius, Lithuania (59 children, mean age 12.3 years) and one in Ventspils, Latvia (31 children, mean age 13.6 years). The reference group consisted of 640

non-Roma children of five Vilnius schools aged 14–15 years. The children were asked about their health self-assessment, the frequency of visits to a doctor during the past year, and the presence and frequency of somatic symptoms (dizziness, vomiting and nausea, abdominal pain, headache and back pain). Most of the children had visited a doctor one to three times during the previous year, the difference between the groups being non-significant. The proportion of children who visited a doctor ten or more times was 10.2% and 16.5% in Vilnius and Ventspils Roma children, respectively, and 6.1% in the reference group. Roma children indicated that they suffered from chronic diseases such as bronchitis, neurodermatitis, heart diseases, and diseases of the immune system, with the prevalence not significantly lower than that in the reference group.

In the Czech Republic, a study Pregnancy Outcome was designed to evaluate human responses to in utero and early childhood exposure to ambient air pollution (Sram et al. 1996; Dejmek et al. 1999). Obstetric data (demographic and medical information) were collected on almost all deliveries in the districts of Teplice and Prachatice from May 1994 through March 1999. The refusal rate was less than 5%. About 13% of mothers delivering at the Department of Obstetrics in the district town Teplice were Roma women. Bobak et al. (2005) concluded that maternal education made the largest single contribution in explaining the poor birth outcomes in Roma mothers, i.e., shorter pregnancy duration and lower birth weight (see also Joubert 1991; Ginter et al. 2001; Rimarova et al. 2004) are largely socioeconomic and that maternal education made the largest single contribution. It is well known that low educational status, high unemployment and poverty of Roma result in a very low socioeconomic status, and may contribute to their worse health (Kolarcik et al. 2009; Voko et al. 2009). This applies not only to Roma, but also to non-Roma populations (Lawlor and Sterne 2007; Voko et al. 2009; Nazroo et al. 2007), and to both adults and children. Pawlinska-Chmara and Wronka (2007) reported that infectious illnesses of the upper and lower respiratory airways, influenza and tonsillitis were more frequent among children from families with a low socioeconomic status and that education of the mother was most strongly related to the prevalence of these diseases. A recently published study on Roma adolescents living in Roma settlements in eastern Slovakia has demonstrated that socioeconomic status decreased the association of self-rated health and health complaints with ethnicity (Kolarcik et al. 2009).

The aim of the present study was to compare morbidity of Roma and non-Roma children in the first 6 years of life and to assess the contribution of low education as a proxy of socioeconomic status to differences between their morbidity.

Methods

Sample

The birth cohort originated from families recruited into the study Pregnancy Outcome. A stratified random sample of 1,492 mother–infant pairs (157 Roma and 1335 non-Roma), i.e., 20% of all deliveries of the Pregnancy Outcome Study, was recruited into the Immune Biomarker Study and samples of maternal and cord blood were collected at delivery. All preterm and low birth weight infants as well as a systematic random sample (i.e., every fifth delivery) of other births were enrolled in the study. During the study, sampling was increased in Prachatice because of the lower birth rate. Friday or weekend deliveries were not enrolled due to the requirement to transport blood to Prague for flow cytometry within 24 h of sample collection.

The children from the Immune Biomarker Study were contacted for follow-up at the age of 3 years (children born during 1994–1996) or at 4.5 years (children born in 1997 and 1998). Pediatricians and pediatric nurses located families, administered the questionnaires, and abstracted the children's medical records. For various reasons 159 (10.7%) children were ineligible for follow-up. Children delivered in 1999 were not contacted. Of families contacted, 48 mothers refused to participate in follow-up and 84 mothers did not fill in the questionnaire. The refusal rate in the follow-up study was 5.4% for births during 1994–1996 and 2.5% during 1997–1998 births (for details, see Hertz-Picciotto et al. 2007). These two phases of follow-up in the two districts comprised 92 Roma children and 1,041 non-Roma children with complete data. In the next phase (in 2005), the medical records of children were abstracted for illnesses up to the age of 6 years. They are available for 1,007 children, because some families moved out of the districts and two pediatricians did not continue in the study. No family refused to continue in follow-up. Thus, we compare morbidity of 66 Roma children (58% of girls) with 466 non-Roma children (52% of girls) born and living in the district of Teplice. The Roma families live in the diffused type of habitation. About 45% of both Roma and non-Roma children lived in the Teplice town district and the other children lived in smaller towns within the district. Moving into other parts of the district was exceptional. The counts of children born in each year of the study (33 in 1994, 64 in 1995, 109 in 1996, 166 in 1997 and 160 in 1998) differ due to the sampling strategy used in the Pregnancy Outcome study. The proportions of Roma and non-Roma children born in each year did not differ.

Measures

Each child was followed up once at the age 3 or 4.5 years and for the second time in the 2005. At the first contact, parents completed a self-administered questionnaire regarding the home environment of the child, breastfeeding, day care, environmental tobacco exposure and other factors potentially related to respiratory illnesses. The parents were also asked for an informed consent to obtain abstractions of medical records of their children. From pediatricians we collected data on vaccinations and data from well-child visits at 18 and 36 months of age, and on ethnicity of children. Codes of ICD-10 (International Classification of Diseases, Tenth Revision) were used to list all diagnoses since birth during both the physician visits and hospitalizations. The dates of the visits or hospitalizations served as a proxy for date of illness occurrence. At the second contact in 2005 we collected abstractions of medical records up to the age of 6 years and data on allergic diseases, i.e., diagnoses, treatment at allergy clinics and results of skin tests. In the present analysis we do not distinguish between hospitalizations and illnesses treated by a pediatrician. The diagnoses were collected into 24 broader groups. The ICD codes of diagnoses the groups consist of are shown in Table 1. The most frequent illnesses were acute upper respiratory infections (URI): J00, acute nasopharyngitis (common cold); J01, acute sinusitis and J02, acute pharyngitis. These distinct diagnoses were united into a larger group (URI) together with the diagnosis J06, URI of multiple and unspecified places. Cumulative incidence of groups of illnesses was evaluated in two age stages: 0–2 and 2–6 years. This is based on the previous experience with statistical models for bronchitis. It was found, that the effects of child's age and of breastfeeding status differed markedly in the first 2 years of life, as compared with later years (Hertz-Picciotto et al. 2007).

Table 1 Groups of illnesses

1. Intestinal infectious diseases	A02–A04, A08, A09
2. Other bacterial diseases	A36–A38, A49, A69.2
3. Viral infections characterized by skin &mucous membrane lesions	B00, B01, B06–B08
4. Viral illnesses	B15, B18, B25–B27, B34
5. Mycoses	B35–B37, B41, B48, B49
6. Parasitic diseases	B58, B77, B80, B86, B88
7. Anemias	D50, D53, D55, D57, D59, D64
8. Nutritional diseases	E50, E55
9. Conjunctivitis	H10
10. Strabismus	H50, H52
11. Otitis media	H65–H67, H92
12. Otitis externa	H60
13. Acute upper respiratory infections	J00–J02, J06
14. Acute tonsillitis	J03
15. Acute laryngitis and tracheitis	J04, J05
16. Influenza	J10, J11
17. Pneumonia	J12, J14–J16, J18
18. Acute bronchitis	J20, J21, J40
19. Stomatitis	K12–K14
20. Diseases of esophagus, stomach and duodenum	K29–K31, K50, K52, K59
21. Hernia	K40–K42
22. Dermatitis	L21–L25, L27–L29, L30, L50
23. Diseases of genitourinary system	N30, N39
24. Digestive system and abdomen	R10, R11, R14

Statistics

Since the frequencies of most illnesses in individual children were extremely variable, negative binomial regression, suitable for overspread variables, was used for multivariate analyses. Differences between the cumulative incidences of illnesses adjusted for gender were determined by the rate ratio (RR), statistically significant probability and the 95% confidence interval not including value 1. The variables used in multivariate statistics were: ethnicity, gender, birth weight, prematurity, length of gestation, breastfeeding, smoking of mothers during pregnancy, smoking of mothers and/or other adults in the household at follow-up, number of children up to 14 years in the household, season of birth, allergies, using coal for cooking/heating, maternal age and maternal education. The highest attained education reported by mothers was used to define three levels of maternal education: (1) primary school or less, (2) attended secondary school, (3) secondary school with final exams, or student, or university. Kruskal–Wallis test of equality of populations was used for bivariate analyses of association of ethnicity with the incidence of illnesses in subgroups of children of mothers with the lowest category of education. All tests were performed using STATA 9 software.

Results

Demographic characteristics

The education of Roma mothers was rather low, as 83% of them finished or at least attended only primary school, while only 16% of non-Roma mothers had only the basic

Table 2 Birth weight, gestation length, breastfeeding and maternal age at birth

Variable	Czech ethnicum Centile (95% CI)	Roma ethnicum centile (95% CI)	Probability
Gestation length (weeks)			
Median	40 (40–40)	39 (38–40)	
25th percentile	39 (39–39)	37 (37–38)	0.0001
Birth weight (g)			
Median	3,350 (3,300–3,400)	2,800 (2,600–3,000)	
25th percentile	3,000 (2,950–3,100)	2,388 (2,200–2,600)	0.0001
Breastfed (months)			
Median	3 (3–4)	3 (2–4)	
75th percentile	7 (6–8)	6 (4–15)	NS
Maternal age (years)			
Median	24 (23–24)	22 (20–23)	
25th percentile	21 (21–22)	20 (19–20)	0.0025

95% CI, binomial exact confidence interval. Probability was computed using Kruskal–Wallis test

level of education. At delivery, Roma mothers were younger (median 22 years) than non-Roma mothers (median 24 years, $P = 0.0025$). The gestation length of Roma pregnancies (median 39 weeks) was shorter than that of non-Roma pregnancies (median 40 weeks, $P = 0.0001$). The birth weight of Roma neonates (median 2,800 g) was less than that of non-Roma neonates (3,350 g, $P = 0.0001$). The length of breastfeeding of Roma and non-Roma infants did not differ (median 3 months). In Table 2, the 25th or 75th percentiles are also shown. Finally, Roma children lived in households with more older siblings (under the age of 14 years) than did non-Roma children—the mean number being 0.7 for non-Roma and 1.7 for Roma families.

Morbidity at the age 0–2 years

The cumulative incidence of 16 groups of illnesses of Roma and non-Roma children is listed in Table 3. The incidence of URI, acute laryngitis and tracheitis, acute tonsillitis, viral infections characterized by skin and mucous lesions, mycoses, parasitic diseases, stomatitis, diseases of stomach and duodenum, symptoms of digestive system and abdomen, and the incidence of diseases of the urinary system did not significantly differ between Roma and non-Roma children. Incidence of following six groups of diagnoses was statistically significantly higher in Roma than in non-Roma children (RR Roma/non-Roma, adjusted for gender) Influenza, RR = 1.62; acute bronchitis, RR = 1.68; intestinal infections diseases, RR = 1.74; pneumonia, RR = 2.19; otitis media, RR = 2.27 and viral diseases, RR = 4.72. The 95% confidence intervals and probability levels are shown in Table 3.

To differentiate between the effects of ethnicity and the education of mothers (as a proxy for socioeconomic situation), we performed bi-variate analysis of the association of these illnesses with ethnicity of children of mothers with the lowest education, i.e., those who had finished or at least attended primary school. The two groups consisted of 53 Roma children and 75 non-Roma children of mothers with elementary education. The incidence of otitis media ($P = 0.037$), influenza ($P = 0.011$), gastrointestinal infections ($P = 0.009$), and viral diseases (0.038) was higher in Roma children. Ethnicity did not have any significant effect on the incidence of bronchitis and pneumonia. The results of multivariate negative binomial regression with all children and other relevant variables led to identical conclusions (data not shown). The incidence of bronchitis and pneumonia was positively associated with the lowest education of mothers without any confounding by other relevant variables in the model.

Morbidity at the age 2–6 years

There was no statistically significant difference between the cumulative incidence of any group of diagnoses listed in Table 3 (data not shown), although there was one exception: the cumulative incidence of acute tonsillitis was lower in Roma than in non-Roma children (RR = 0.69, $P = 0.01$, 95% confidence interval 0.51–0.93). Kruskal–Wallis test with children matched by the lowest category of education of mothers did not prove ethnicity as a factor responsible for this difference and in multivariate analysis the incidence of tonsillitis was significantly negatively associated with the elementary education of the mother (RR = 0.69, $P = 0.001$) and with using coal for heating the flat/home (RR = 0.49, $P = 0.008$).

Allergic diseases

Allergies occurred extremely rarely in Roma children, as can be seen in Table 4. Only two children were examined

Table 3 Cumulative incidence of illnesses from birth to 2 years of age in children born and living in the district of Teplice

	Ethnicum		Negative binomial regression		
	Czech	Roma	Prob.	RR	95% CI
Upper respiratory infections (13[a])	2.26	2.74	NS		
Laryngitis and tracheitis (15)	0.76	0.94	NS		
Tonsillitis (14)	0.57	0.53	NS		
Influenza (16)	0.59	0.95	0.005	1.62	1.16–2.27
Bronchitis (18)	1.09	1.83	0.000	1.68	1.26–2.25
Pneumonia (17)	0.11	0.23	0.029	2.19	1.08–4.43
Otitis media (11)	0.53	1.21	0.000	2.27	1.49–3.45
Intestinal infectious diseases (1)	0.30	0.52	0.030	1.74	1.06–2.85
Disease of stomach and duodenum (20)	0.47	0.62	NS		
Viral infections SMML[b] (3)	0.12	0.03	NS		
Viral illnesses (4)	0.01	0.08	0.010	6.33	1.57–25.55
Mycoses (5)	0.06	0.02	NS		
Parasitic diseases (6)	0.02	0.09	NS		
Stomatitis (19)	0.07	0.06	NS		
Digestive system and abdomen (24)	0.05	0.03	NS		
Disease of the urinary system (23)	0.05	0.11	NS		

RR rate ratio Roma/Czech ethnicum adjusted for gender, *Prob.* probability, *CI* confidence interval

[a] Group of diagnoses in Table 1

[b] Characterized by skin and mucous membrane lesions

Table 4 Prevalence of allergies in children of the Roma ethnicum ($N = 66$) and Czech ethnicum ($N = 466$)

	Children	
	Roma *N* (%)	Non-Roma *N* (%)
Asthma bronchiale	1 (1.5)	41 (8.8)
Allergic rhinitis	2 (3.0)	33 (7.1)
Atopic dermatitis	0 (0)	44 (9.4)
Drug allergy	1 (1.5)	22 (4.7)
At allergology clinic	2 (3)	70 (15.0)

by an allergist, one child was diagnosed with asthma bronchiale (we do not know the results of skin tests), two children with allergic rhinitis (one of them had positive skin tests, the other was not tested) and one child experienced a drug allergy.

Exposure to environmental tobacco smoke (ETS)

Roma children were heavily exposed to ETS. According to the questionnaire data, 80% of Roma mothers smoked during pregnancy and 73.4% of them smoked at the time of follow-up (when their children were 3 or 4.5 years old). The percentages of smokers among non-Roma mothers were 36 and 35%, respectively. Taking into account all the adult smokers in the household, there were 41% of non-Roma households without adult smokers. In contrast, only 9% of Roma children lived without any smoker in the family.

Discussion

The present study aimed at comparing the morbidity of the Roma and non-Roma children in the age 0–2 and 2–6 years. We have found, that in the period 0–2 years, the Roma children had statistically significantly higher cumulative incidence of bronchitis, pneumonia, viral diseases, otitis media, influenza and intestinal infections as compared to non-Roma children. When children were matched according to the education of mothers and only children of the mothers with the lowest level of education were compared, ethnicity was statistically significantly related to the incidence of influenza, otitis media, intestinal infectious diseases and viral diseases. The incidence of bronchitis and pneumonia was not statistically associated with ethnicity, and multivariate analysis of all children has shown that these illnesses are associated with the level of education of mothers. Thus, the relation of maternal education and ethnicity to increased morbidity of Roma children is rather complex. Ethnicity can be considered, according to Voko et al. (2009) as an explanatory variable related, for instance, to elements of health behavior, and this holds true for all elements not

characterized by sensitive covariates. Moreover, there are many prenatal as well as postnatal factors related to both ethnicity and socioeconomic status that can influence the morbidity of children.

The high RR in the case of viral illnesses is based on small numbers. They were diagnosed in five Roma children (acute hepatitis A, infectious mononucleosis and cytomegaloviral disease) and five non-Roma children, so that the proportions differ. The increased incidence of otitis media in Roma children was attributable to both children diagnosed with otitis once or twice and to children with recurrent otitis (three times and more). The increased incidence of bronchitis was due solely to the more frequent occurrence of recurrent bronchitis (four times and more), and also the higher incidence of influenza was due to more children repeatedly diagnosed with influenza. The cumulative incidence of diseases of the genitourinary system was non-significantly higher in Roma children both in the younger and older age groups. Therefore, we have compared the cumulative incidence from birth to 6 years of age. The difference between the Roma and non-Roma children remained very closely under the level of significance and association of ethnicity with the RR was confounded by the more frequent occurrence of urogenital diseases in girls.

It is difficult to hypothesize why the difference between morbidity of Roma and non-Roma children is limited to the first 2 years of life. In the literature, there is no data on the morbidity of preschool Roma children living in a diffuse type of habitation with which to confirm or contrast our findings. Maternal smoking during pregnancy as well as postnatally is a well-known risk factor for both respiratory diseases and otitis media (DiFranza et al. 2004). Their respiratory risks are believed to be independent, and greatest during fetal development and the first few years of life. Postnatally, occurrence of bronchitis has been shown to be also associated with preceding high ambient levels of PAHs and $PM_{2.5}$ and with heating using coal (Hertz-Picciotto et al. 2007). Using coal for heating can be associated with a low socioeconomic status. In our study, otitis media is the illness most clearly associated with ethnicity. Also, Suarez et al. (1984) reported a higher morbidity of Roma children with secretory otitis media. Otitis media is one of the most common childhood infections in young children with most infections occurring before the age of 2 years (Brauer et al. 2006). Other risk factors for otitis media—apart of maternal smoking—are: low vitamin A and C intake (Heinrich and Raghuyamshi 2004), several siblings at home (Pukander et al. 1985), child care outside the home (Uhari et al. 1996), low socioeconomic status (Rovers et al. 2006) and exposure to moulds and to secondary heating sources (Pettigrew et al. 2004a, b). The latter factors can also be associated with low socioeconomic status. Reccurrent otitis proliferates in families and exhibits substantial heritability (Daly et al. 2004).

Dejmek et al. (2002) reported significantly decreased vitamin C levels both in Roma mothers and their babies. Rambouskova et al. (2009) found that smoking by Roma mothers during pregnancy was associated with decreased concentrations of blood folate. Pregnant Roma women consumed dietary supplements less frequently during pregnancy than pregnant women from the Czech ethnicum and their blood concentrations of folate, retinol, β-carotene, and α-tocopherol were significantly lower than those of non-Roma mothers. The plasma folic acid levels of Roma mothers were marginal and β-carotene values were inadequate. These dietary deficiencies may negatively influence development of the immune system. Hypothetically, a prenatally and/or postnatally induced delay of development of immune defenses could contribute to the decreased resistance to infectious diseases in the first 2 years of life of Roma children. The higher incidence of intestinal infections in Roma children may also be related to delayed maturation of the mucosal immune system. Alternatively, illnesses of Roma children in the older age could be underdiagnosed because of the difference between Roma and non-Roma mothers in their propensity to see a doctor when a child is sick as suggested by Kanapeckiene et al. (2009). We are not inclined to accept this explanation, although admittedly we see no way to definitively exclude such a possibility. However, the health care of Roma children (as of all other children in the Czech Republic) is paid for by the state. Each child has to be registered with a pediatrician, obtains a complete vaccination scheme, and passes through mandatory health checkups. Thus, there is no problem with access to health care. This is also evidenced by a similar incidence of URI of Roma and non-Roma children, since these are less serious diseases, in contrast to, for instance, otitis media or pneumonia.

The second clear-cut difference between Roma and non-Roma children is the extremely low prevalence of allergies (asthma bronchiale, allergic rhinitis and atopic eczema) diagnosed by pediatricians and/or allergists in Roma children. Monasta et al. (2008) studied the prevalence of asthma and the incidence of asthma symptoms in 137 Roma families from Macedonia and Kosovo living in Roma settlements located in five cities in northern and central Italy and reported about the frequent respiratory symptoms associated with the quality of housing. In the abstract of his paper (written in Italian), the author does not state whether he is referring to atopic or non-atopic asthma. We have discussed the situation we found in the Teplice district, i.e., an extremely low occurrence of diagnosed allergic diseases in Roma children, with a number of pediatricians in other districts of the Czech Republic, and all of them confirmed our finding.

Strength and limitations

Our study was based on the extensive cooperation of pediatricians and pediatric nurses in the district. Refusal to participate in the study was exceptional. The data on the morbidity of children were obtained from pediatric records, thus visits to specialists or to hospitals were also included. The Roma children in our Teplice cohort were registered with 20 pediatricians, the non-Roma children with 27 pediatricians, thus the use of ICD-coded physician diagnoses minimizes errors due to the different approaches of the pediatricians taking part in the study. The main limitation is certainly a relatively low number of the Roma children which matters in case of illnesses with a low incidence. Another limitation is that apart from education we do not have any other socioeconomic indicator (income and employment) for analysis of association of socioeconomic status of families with the health outcomes of children.

The future studies should be specifically designed to collect more covariates on the living conditions, life style, socioeconomic status and health-related behaviors of Roma families to be able to evaluate their contribution to preschool children health. These data should be obtained by trained interviewers.

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