Research: Epidemiology

First report on the nationwide incidence and prevalence of Type 1 diabetes among children in Turkey

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Abstract

Aim   To report, for the first time, the incidence and prevalence of childhood Type 1 diabetes in Turkey using a nationwide registry.

Methods   Information on birth date, city of birth, diagnosis date and gender of all patients with Type 1 diabetes aged < 18 years were obtained from the Turkish Social Security Institute for the period from January 2011 to December 2013.

Results   There were 17 175 prevalent cases of Type 1 diabetes over the 3-year period. The prevalence of Type 1 diabetes was 0.75/1 000 (95% CI 0.74–0.76) and was higher in girls than in boys (0.79 vs 0.72 /1 000; $P < 0.01$). There were 2465 incident cases in 2013. The incidence was slightly higher among girls (50.6%) than boys (49.4%); the girl:boy case ratio was 1.02. The incidence was 10.4/100 000 for boys and 11.3/100 000 for girls. The age-standardized incidence rate was 10.8 per 100 000 (95% CI 10.1–11.5) according to the WHO standard population, estimated using the direct method. The mean patient age at diagnosis was 10.6 ± 4.6 years. The highest proportion of cases (40.6%) was diagnosed in children aged 10–14 years.

Conclusions   This is the first study to report the incidence and prevalence of Type 1 diabetes in children in Turkey. The incidence of Type 1 diabetes reflects the geographical location of Turkey, bridging Asia and Europe, with the incidence being higher than in Asia but lower than in Europe.

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Introduction

Type 1 diabetes is one of the most prevalent long term diseases of childhood globally. It has major health consequences for individuals and society [1]. Numerous studies have reported an increasing incidence of Type 1 diabetes in children worldwide [2–4], with significant variation in incidence by country [2]. The highest rates have been reported in Finland (64.2 and 64.3 per 100 000 per year for children aged 0–14 years in 2005 and 2011, respectively [5,6]), and Sweden, with 43.9 per 100 000 per year during 2005–2007 [7]. The lowest rates have been reported in China (0.1–4.5/100 000), Pakistan (0.5/100 000) and Venezuela (0.1/100 000 yearly) [2]. The variation in incidence rates may be a consequence of differences in ethnic background, environmental factors related to geographical region and climate, and/or the level of industrial development and urbanization [4,8]. Data acquired from different countries, especially those with low and high incidence rates of Type 1 diabetes, are therefore important for understanding global disease patterns and putative aetiological factors.

Published data on the incidence and prevalence of Type 1 diabetes among children in Turkey are scarce [9–11] and none of the previous studies were based on population-based registry data. Indeed, the lack of nationwide data on paediatric diabetes from Turkey was highlighted in the International Diabetes Federation 2011 Diabetes Atlas [12]. The aim of the present study, therefore, was to determine the nationwide incidence and prevalence of Type 1 diabetes among children aged < 18 years living in Turkey.

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What's new?

- This is the first study to report the nationwide prevalence and incidence of childhood Type 1 diabetes in Turkey.

- The study was given the award for best oral presentation at 35th Union of Middle-Eastern and Mediterranean Pediatric Societies (UMEMPS) Congress.

Patients and methods

Study design and data collection

Data from the Turkish Social Security Institute were used to identify children aged < 18 years diagnosed with Type 1 diabetes. According to the legal arrangements enacted in 2008, the three major public healthcare institutions in Turkey were unified under the umbrella of the Turkish Social Security Institute to provide Universal Health Insurance. This regulation introduced a state guarantee for healthcare expenditure for all children (age < 18 years). Additionally, private health insurance is often used as a complement to public health insurance in Turkey. Companies paying for special insurance for their employees are also obliged to provide general health insurance. Moreover, for patients diagnosed with Type 1 diabetes, all expenses are covered by the universal health insurance, because it is a long term and costly disease. Virtually all patients with diabetes are obliged to register with the universal health insurance system to obtain essential medicines, which includes insulin; therefore, we believe we can assume that all of the children with Type 1 diabetes have records in the Turkish Social Security Institute (estimate 99.9%). In addition, all reports are renewed biennially; therefore, the risk of patient record loss is minimized.

Case data from 1 January 2011 to 31 December 2013 were used for the present study. Information on birth date, gender, date of diagnosis of diabetes (defined as date of commencement of insulin), date of most recent report, city of birth and the centre issuing the report, for all cases of Type 1 diabetes (based on ICD codes) aged < 18 years, were collected from the Turkish Social Security Institute records. The diagnosis of Type 1 diabetes was made by a physician according to the American Diabetes Association classification [13]. Case data were merged and analysed for duplicates to ensure that cases reported by more than one centre were not counted twice. Cases of other forms of diabetes (such as Type 2 diabetes, monogenic diabetes, secondary diabetes) were excluded on the basis of clinical diagnosis and prescription drug history (for example, transient use of insulin, treatment with oral antidiabetic agents alone).

Census data were obtained from the address-based population registration system of the Turkish Statistical Institute.

In 2013, the population of Turkey was 76 667 864, of whom 22 795 162 were aged < 18 years. Of these, 11 091 237 (48.7%) were girls and 11 703 925 (51.3%) were boys.

Approval for this study was obtained from Gülhane Military Medical Academy Ethics Committee.

Statistical analysis

Incidence and prevalence rates of Type 1 diabetes were calculated using the number of patients overall and by age group (0–4, 5–9, 10–14 and 15–18 years), gender and region. Population census data were used for the denominator. Incidence rates specific to place of birth (based on five regions) and for each of the 81 cities in Turkey were also estimated.

'Prevalence' was calculated as the total number of existing cases of Type 1 diabetes in children aged < 18 years as of 31 December 2013 divided by the total population of children aged < 18 years. Prevalence is reported as cases/1 000, with 95% CIs.

'Incidence' was calculated as the number of new cases of Type 1 diabetes in children aged < 18 years, divided by the total population aged < 18 years, and is reported per 100 000 person years with 95% CIs, assuming a Poisson distribution of cases. Age-standardized incidence rates were estimated using the direct (age-adjusted) method: this weights data based on the relative age distribution of a standard population and enables incidence rates to be compared among populations that have different age distributions. The WHO-standardized age distributions were used for adjustment [14].

Incidence rates specific to the place of birth (province) were calculated as the number of new cases of Type 1 diabetes in a given province per year divided by the population of children aged < 18 years residing that province.

Incidence rates specific to the place of birth (region) were calculated as the number of new cases of Type 1 diabetes in a given region per year divided by the population of children aged < 18 years in that region.

Age-specific incidence rates were calculated for age and gender groups (girls and boys aged 0–4, 5–9, 10–14 and 15–18 years).

Results

Prevalence

A total of 17 175 prevalent cases of Type 1 diabetes in children aged < 18 years were identified (Table 1). The girl: boy ratio was 1.05.

The prevalence of Type 1 diabetes was 0.75/1 000 (95% CI 0.74–0.76). The prevalence was higher for girls (0.79/1 000) than boys (0.72/1 000; $P < 0.01$). Most children

Table 1 Number of cases and prevalence rates of Type 1 diabetes by age group and gender

	Population at risk	Total patients in age group	Prevalence rate per 1000	95% CI
0–18 years				
Girls	11 090 402	8804	0.79	0.78–0.80
Boys	11 698 857	8371	0.72	0.71–0.73
Total	22 789 259	17 175	0.75	0.74–0.76
0–4 years				
Girls	2 429 023	467	0.19	0.18–0.20
Boys	2 563 285	456	0.18	0.17–0.19
Total	4 992 308	923	0.19	0.18–0.20
5–9 years				
Girls	3 003 671	1699	0.57	0.55–0.58
Boys	3 167 777	1579	0.50	0.49–0.51
Total	6 171 448	3278	0.53	0.52–0.54
10–14 years				
Girls	3 161 019	3501	1.11	1.09–1.13
Boys	3 330 323	3342	1.00	0.98–1.02
Total	6 491 342	6843	1.05	1.04–1.17
15–18 years				
Girls	2 496 688	3137	1.26	1.23–1.28
Boys	2 637 471	2992	1.14	1.11–1.16
Total	5 134 159	6129	1.19	1.18–1.21
0–14 years				
Girls	8 593 714	5667	0.66	0.64–0.67
Boys	9 061 385	5379	0.59	0.58–0.60
Total	17 655 099	11 046	0.63	0.62–0.65
6–18 years				
Girls	8 041 680	8081	1.01	0.99–1.02
Boys	8 482 576	7679	0.91	0.89–0.92
Total	16 524 256	15 760	0.95	0.94–0.96

Table 2 Number of cases and incidence rates of Type 1 diabetes by age groups and gender

	Number of new cases	Incidence Rate per 100 000	95% CI
0–18 years			
Girls	1247	11.3	10.9–11.6
Boys	1218	10.4	10.1–10.8
Total	2465	10.8	10.6–11.1
0–4 years			
Girls	184	7.6	7.0–7.7
Boys	180	7.0	6.4–7.6
Total	364	7.3	7.0–8.2
5–9 years			
Girls	337	11.2	10.0–11.5
Boys	296	9.4	8.7–10.0
Total	633	10.3	9.8–10.7
10–14 years			
Girls	490	15.5	14.7–16.1
Boys	510	15.3	14.6–16.1
Total	1000	15.4	14.7–16.3
15–18 years			
Girls	235	9.4	8.7–10.1
Boys	232	8.8	8.1–9.5
Total	467	9.1	8.7–10.1
0–14 years			
Girls	1012	11.8	11.4–12.2
Boys	986	10.9	10.5–11.3
Total	1998	11.3	11.0–11.6
6–18 years			
Girls	998	12.4	12.0–12.9
Boys	973	11.5	11.1–11.9
Total	1.971	11.9	11.6–12.2

(39.8%) were diagnosed between the ages of 10 and 14 years, followed by the age groups 15–18 years (35.7%), 5–9 years (19.1%) and 0–4 years (5.4%). The prevalence of diabetes increased with age from 0.19/1 000 in 0–4-year-olds to 1.19 cases/1 000 in 15–18-year-olds (Table 1).

Incidence

A total of 2465 incident diabetes cases were identified in people aged < 18 years in 2013. Of these, 1247 were girls (50.6%) and 1218 (49.4%) were boys. The girl:boy ratio was 1.02. The incidence was 10.8/100 000 (95% CI 10.6–11.1) among children aged 0–18 years. The mean incidence rate for boys was 10.4/100 000 (95% CI 10.1–10.8), and for girls it was 11.3/100 000 (95% CI 10.9–11.6; Table 2). Girls had a 1.1-fold higher rate ratio compared with boys (Table 3). The mean age of the children at diagnosis was 10.6 ± 4.6 years and was slightly higher in boys (10.7 ± 4.6) than girls (10.5 ± 4.5). The standardized incidence rate was 10.8 per 100 000 (95% CI 10.1–11.5) according to the WHO standard population [14].

The proportion of incident cases was highest in children aged 10–14 years (40.6%), followed by the age groups 5–9 years (25.7%), 15–18 years (18.9%) and 0–4 years (14.8%). Incidence increased significantly with age, reaching

Table 3 Risk ratios for different age groups and regions

	Risk ratio (95% CI)	P
Sex		
Girls	Reference group	
Boys	1.10 (1.07–1.13)	< 0.001
Age groups		
0–4 years	Reference group	
5–9 years	1.72 (1.51–1.96)	< 0.001
10–14 years	2.68 (2.38–3.02)	< 0.001
15–18 years	1.53 (1.34–1.76)	< 0.001
Regions		
East	Reference group	
South	1.25 (1.19–1.31)	< 0.001
West	1.42 (1.36–1.47)	< 0.001
North	1.53 (1.44–1.62)	< 0.001
Middle	1.64 (1.57–1.71)	< 0.001

a peak in the age group 10–14 years, with 15.4 cases/100 000 (95% CI 14.7–16.3). Incidence then declined at age 15–18 years (Table 2), while the lowest incidence rate was seen in the age group 0–4 years (Table 2 and Fig 1). The incidence rate for the age group 0–14 years was 11.3 cases/100 000 (95% CI 11.0–11.6). Compared with the age group 0–4 years, the incidence rate ratio was 1.7-fold higher in the age group 5–9 years, 2.7-fold higher in the age group

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10–14 years and 1.5-fold higher in the age group 15–18 years (Table 3). This trend was evident in the total patient population as well as separately by gender.

The numbers of incident cases with Type 1 diabetes according to city of birth, in 81 cities in Turkey, are shown in
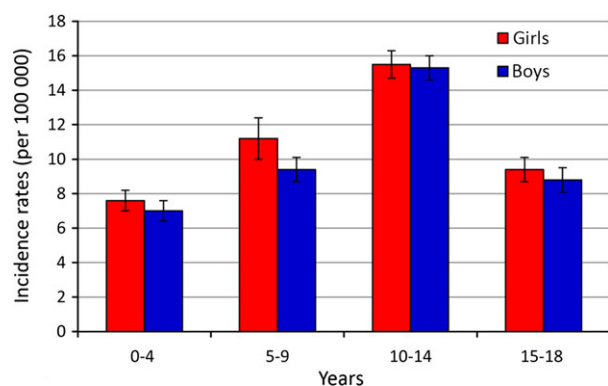

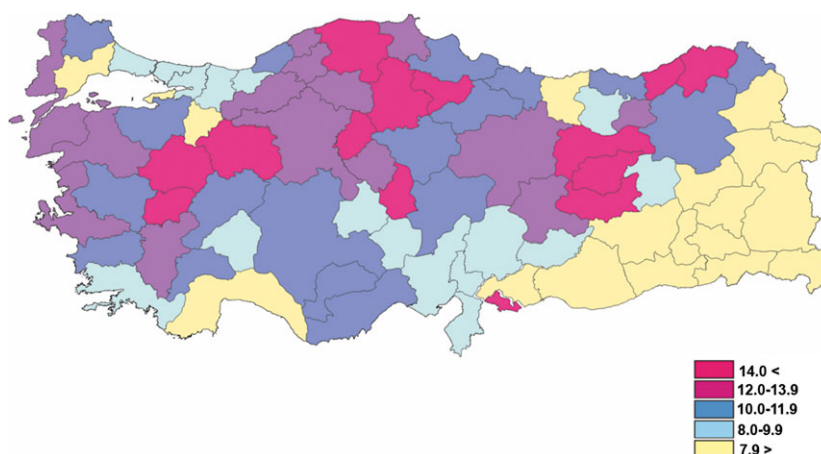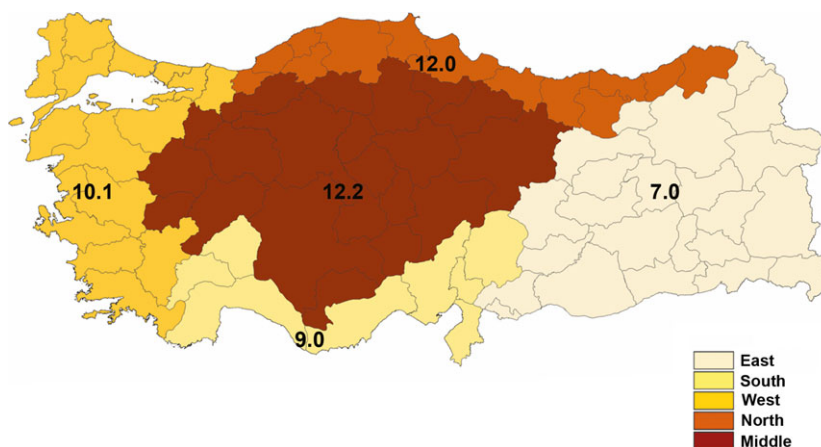FIGURE 1 Type 1 diabetes incidence rates according to city of residence (per 100 000).

Fig. 2. The highest incidence rates were observed in Tunceli, Artvin and Kırıkkale, in declining order. Incidence rates according to the regions of the cities of birth of patients with newly diagnosed Type 1 diabetes are shown in Fig. 3, which gives the five official statistical regions of Turkey, according to the Turkish Statistical Institute. Compared with the Eastern region, which has the lowest incidence rates, the risk of having Type 1 diabetes was 1.25-, 1.42-, 1.53- and 1.64-fold higher in the southern, western, northern and middle regions of Turkey, respectively.

Discussion

This is the first nationwide, population-based report of Type 1 diabetes incidence and prevalence among young people aged < 18 years residing in Turkey. The caseload of children with Type 1 diabetes is very large; there are 17 175 young people with documented Type 1 diabetes in Turkey, which represents ~3% of the ~500 000 prevalent cases of Type 1 diabetes globally [15]. The age-standardized incidence of

FIGURE 2 Type 1 diabetes incidence rates according to city of residence (per 100 000).

FIGURE 3 Type 1 diabetes incidence rates according to geographical region (per 100 000).

Table 4 Comparison of prevalence rates of Type 1 diabetes in studies reported from Turkey (per 1000)

	Akesen et al. [9] 2009, Istanbul	Demirbilek et al. [10] 2012, Diyarbakır	Our study Nationwide	
Elementary school (6–11yr)	0.57	0.35	5–9yr	0.53
Intermediate School (11–14)	0.69	0.49	10–14yr	1.05
High school (14–18yr)	0.92	0.49	15–18yr	1.19
Total (6–18yr)	0.67	0.42	6–18yr	0.95

Type 1 diabetes of 10.8/100 000 is in the mid-range of incidence compared with rates internationally [1,15]. There are limited data on incidence in children aged > 14 years; we confirmed the peak incidence occurs in the age group 10–14 years, with a significantly lower incidence in those aged 15–18 years. We observed a modest female gender bias, which contrasts with a male gender bias often observed in countries of high incidence.

Few studies have reported prevalence of childhood Type 1 diabetes. Our prevalence rate of 0.75/1.000 among young people aged < 18 years is lower than reported in the SEARCH for Diabetes in Youth Study in 2009 [16,17] (1.93/1000), in NSW Australia in 2010 (1.5/1000), in Castilla-Leon in Spain in 2004 (1.18/1000) [18] and in Saudi Arabia in 2001–2007 (1.09/1000) [19]. The reporting of prevalence data is important as it defines the caseload of children who have Type 1 diabetes, which is essential for healthcare planning and resource allocation.

There are only two published studies that have previously reported the epidemiology of Type 1 diabetes among children in Turkey [9,10] (Table 4). Both were regional/local studies; one conducted in Istanbul and the other in Diyarbakır. Akesen et al. [9] reported a prevalence rate of 0.67/1000 in 2009. The lower estimate compared with our data is likely to result from the method of case ascertainment (students treated with insulin reported to the Ministry of Education data), the population studied (local vs nationwide) and the different dates covered by the studies (2009 vs 2011–2013). The prevalence in the Diyarbakır region in 2012 was also lower (0.42/1000) using Ministry of Education estimates [10]. The present study confirms the importance of using a national, population-based registry and ascertaining cases using a method by which few cases will be missed (such as a mandatory reporting system).

Turkey's location represents a bridge between Europe, where the incidence of Type 1 diabetes is high, and Asia, where the incidence is low. The incidence rate of 11.3/100 000 for 0–14-year-olds is similar to that of some of the neighbouring countries in the Balkan region, including Greece (10.0/100 000), West Bulgaria (10.7/100 000) [2], Croatia (10.4/100 000), Slovenia (14.6/100 000) and Romania (14.5/100 000) [20]. This suggests these nations share similar genetic predisposition and/or environmental triggers. Other European countries tend to have intermediate to high incidence rates, with a crude tendency to decrease from Western and Northern to Eastern and Southeastern Europe [3,15]. By contrast, these rates are clearly higher than in Albania (3.9/100 000) and Bosnia and Herzegovina (3.5/100 000) [10], which are located beside the Adriatic Sea, relatively far from Turkey. It is also possible there may be under-ascertainment of cases in these nations. In contrast, higher incidence rates have been reported from the Arabian Peninsula (29/100 000 among 0–12-year-olds in Al-Madinah, North West Saudi Arabia (2004–2009) [21]) and the Kingdom of Saudi Arabia (with an alarming increase from 18.05 to 36.99/100 000 in last 9 years [22]).

A strength of the present study is its population-based ascertainment of cases using the nationwide Turkish Social Security Institute, which covers the healthcare expenditure of the vast majority (> 99%) of people aged < 18 years. Because reporting of cases should be performed biennially, the risk of patient record loss is minimized. A limitation of the study is that we were unable to confirm case ascertainment from a second source, such as hospital admission data or membership of diabetes organizations; however, because of the necessity to register with the Turkish Health insurance system to obtain supply of insulin, we estimate that very few cases would have been missed. It is possible that some cases registered on the system may have been diagnosed in another country before moving to Turkey (which could overestimate prevalence); however, we estimate that this would represent a very small number of cases.

In conclusion, this is the first study to report nationwide incidence and prevalence rates of Type 1 diabetes among 0–18-year-olds. These data are important to ensure that national strategies reflect evidence-based data, but also provide data on the global burden of childhood diabetes. Future studies should address changes in rates over time, to examine whether there is a rising incidence in Turkey as reported in many other countries globally.

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