Health Promotion Perspectives

Mobasseri et al, **Health Promotion Perspectives**, 2020, 10(2), 98-115
doi: 10.34172/hpp.2020.18
https://hpp.tbzmed.ac.ir

TUOMS PRESS

Systematic Review

Prevalence and incidence of type 1 diabetes in the world: a systematic review and meta-analysis

Majid Mobasseri[1], Masoud Shirmohammadi[2], Tarlan Amiri[3], Nafiseh Vahed[4,5], Hossein Hosseini Fard[5], Morteza Ghojazadeh[5*]

[1]Endocrine Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[2]Liver and Gastrointestinal Diseases Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[3]Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran
[4]Emergency Medicine Research Team, Tabriz University of Medical Sciences, Tabriz, Iran
[5]Research Center for Evidence-Based Medicine, Iranian EBM Centre: A Joanna Briggs Institute Affiliated Group, Tabriz University of Medical Sciences, Tabriz, Iran

ARTICLE INFO

Article History:
Received: 28 Sep. 2019
Accepted: 26 Oct. 2019
ePublished: 30 Mar. 2020

Keywords:
Diabetes mellitus, Incidence, Prevalence, Systematic review, Type 1, World

*Corresponding Author:

Morteza Ghojazadeh,
Email:
ghojazadehm@hotmail.com

Abstract

Background: Diabetes is referred to a group of diseases characterized by high glucose levels in blood. It is caused by a deficiency in the production or function of insulin or both, which can occur because of different reasons, resulting in protein and lipid metabolic disorders. The aim of this study was to systematically review the prevalence and incidence of type 1 diabetes in the world.

Methods: A systematic search of resources was conducted to investigate the prevalence and incidence of type 1 diabetes in the world. The databases of Medline (via PubMed and Ovid), ProQuest, Scopus, and Web of Science from January 1980 to September 2019 were searched to locate English articles. The located articles were screened in multiple levels of title, abstract, and full-text and final studies that met the inclusion criteria were retrieved and included in the study.

Results: From the located articles, 191 publications were included in this systematic review. The results of the meta-analysis showed that the incidence of type 1 diabetes was 15 per 100,000 people, and its prevalence was 0.075% (95% CI = 0.051% to 0.11%) worldwide, both of which were statistically significant.

Conclusion: According to the results, the incidence and prevalence of type 1 diabetes are increasing in the world. As a result, insulin will be difficult to access and afford, especially in underdeveloped and developing countries.

Keywords: Diabetes mellitus, Incidence, Prevalence, Systematic review, Type 1, World

Introduction

Diabetes is referred to a group of diseases characterized by high glucose levels in blood. It is caused by a deficiency in the production or function of insulin or both, which can occur because of different reasons, resulting in protein and lipid metabolic disorders.[1] The long-term effects of hypoglycemia are tissue and organ damage.[2]

Symptoms of diabetes include polyuria, thirst, vision disorders, and weight loss. In some cases there are more severe forms of diabetic ketoacidosis and hyperosmolar that may lead to stupor and coma. But most symptoms are not severe, which may cause damage or even failure of different organs in the long run and lead to irreparable injuries such as blindness, amputation, stroke and eventually death. Previously, type 1 diabetes was called insulin-dependent diabetes and it could happen at any age but is most common in children and young people.[3]

People with type 1 diabetes are not able to produce enough insulin. This type constitutes about 5%–10% of all cases of diabetes. In this type, the cellular destruction of beta cells occurs in the pancreas. In type 1 diabetes, the pancreas does not release any insulin. Since there is no epidemiologically accurate information on the prevalence and incidence of type 1 diabetes in the world and in the region, therefore, the present study was designed and implemented as a systematic review and meta-analysis, because of geopolitical map of the policy on the prevention and treatment of this disease can be done better.

Materials and Methods

In this systematic review and meta-analysis, a systematic search of resources was conducted by a librarian (N.V.) to

investigate the prevalence and incidence of type 1 diabetes (condition) in the people (population) of the world (context). The PICO of study based on the JBI protocol as CoCoPop for prevalence and incidence studies.

Data sources and search strategy

The databases of Medline via (PubMed, Ovid), Embase, Scopus, Web of Science from January 1980 to September 2019 were searched to locate English articles. Also, SID, Magiran, and Barakat databases were searched for Persian studies. The grey literature and ongoing studies were searched using the following: OpenGrey, Google Scholar and for thesis and dissertations ProQuest and studies presented at conferences were also searched. Also, experts and professionals on this subject were reached and their opinions were gathered for information on published and unpublished studies. The search was performed using MESH and free keywords. The keywords selected for the search were: "type 1 diabetes", "prevalence", and "incidence" with this search strategy: ((("Diabetes Mellitus, Type 1"[Mesh]) OR ((((((((((((((((((((IDDM[Title/Abstract]) OR T1DM[Title/Abstract]) OR "Type 1 Diabetes"[Title/Abstract]) OR "Autoimmune Diabetes"[Title/Abstract]) OR "Juvenile Onset Diabetes"[Title/Abstract]) OR "Juvenile-Onset Diabetes"[Title/Abstract]) OR "Brittle Diabetes Mellitus"[Title/Abstract]) OR "brittle diabetes"[Title/Abstract]) OR "diabetes mellitus type 1"[Title/Abstract]) OR "diabetes mellitus type I"[Title/Abstract]) OR "diabetes type 1"[Title/Abstract]) OR "diabetes type I"[Title/Abstract]) OR "early onset diabetes mellitus"[Title/Abstract]) OR "insulin dependent diabetes"[Title/Abstract]) OR "juvenile diabetes"[Title/Abstract]) OR "juvenile diabetes mellitus"[Title/Abstract]) OR "type I diabetes"[Title/Abstract]) OR "type I diabetes mellitus"[Title/Abstract]) OR "Insulin Dependent Diabetes Mellitus"[Title/Abstract]) OR "Insulin-Dependent Diabetes Mellitus"[Title/Abstract]))) AND ((((("Prevalence"[Mesh]) OR ((Prevalence[Title/Abstract]) OR Prevalences[Title/Abstract]))) OR (("Incidence"[Mesh]) OR ((Incidence[Title/Abstract]) OR Incidences[Title/Abstract])))). The complete search strategy of Medline and Embase is in Supplementary file 1.

Inclusion and exclusion criteria

Inclusion criteria for selecting studies include: 1. Articles published between 1980 and 2019; 2. Articles published in English and Persian. The exclusion criteria were: 1. Studies with no reported sample size; 2. Studies that had low quality; 3. Studies that were published before 1990.

Study selection

The located articles were screened in multiple levels of title, abstract, and full-text and final studies that met the inclusion criteria were retrieved and included in the study. The studies were critically appraised by 2 subject specialists and low-quality studies were excluded. In cases of disagreements between two experts (M.M. and M.S.) at each stage of selection and appraisal, third person opinion was used.

Quality appraisal

Articles were evaluated using the STROBE checklist. In this checklist, the minimum score was 2 and the maximum was 4. Finally, articles that received a score of 4 on checklist questions were included in the research, 128 articles earned 4 score, 46 articles earned 3 score and 19 articles earned 2 score and finally their data were extracted to perform the meta-analysis.

Data extraction and quality assessment

The information extracted from the articles were entered in the extraction form. Extracted data included: first author, year of publication, country of study, sample size, and incidence of diabetes in the studies.

Statistical analysis

Statistical analysis was performed using CMA v.2.0 software and P value less than 0.05 was considered as significant. The binomial distribution was used to calculate the variance. Weighted mean was used to combine the prevalence rate of different studies. Meta-analysis was used to obtain the incidence of type 1 diabetes. The heterogeneity between studies was assessed by Cochran (Q) and I^2 statistics, which expressed the percentage of variation between studies. Random effects model was used to calculate the overall and pooled effect size. Pooled estimates and 95% confidence intervals (CIs) were reported as percentages for the prevalence of type 1 diabetes and as new cases per 100 population for incidence.

Results

Search results and study characteristics

In a systematic search of sources, 65 765 articles were identified. A total of 58 239 articles were duplicates, and 7107 were excluded after reviewing the title and abstract of the articles. After reviewing the full-text articles, 228 articles were excluded. Finally, 191 publications were included in the systematic review and meta-analysis. Figure 1 shows the identified and retrieved articles in the study. Table 1 summarizes the general characteristics of incidence studies; Table 2 presents findings on the prevalence and incidence of type 1 diabetes; and Table 3 outlines the general characteristics of prevalence studies.

Prevalence and incidence of type 1 diabetes in Asia

Prevalence and incidence of type 1 diabetes were extracted from meta-analysis studies. In type 1 diabetes incidence, the heterogeneity between studies in the meta-analysis was significant ($Q = 50.51$; $df = 16$; $P < 0.001$; $I^2 = 68.33$), and in the prevalence of diabetes 1, the heterogeneity was also significant ($Q = 651.7$; $df = 5$; $P < 0.001$; $I^2 = 99.23$). The incidence of type 1 diabetes in Asia was 15 per 100 000 population, which was statistically significant

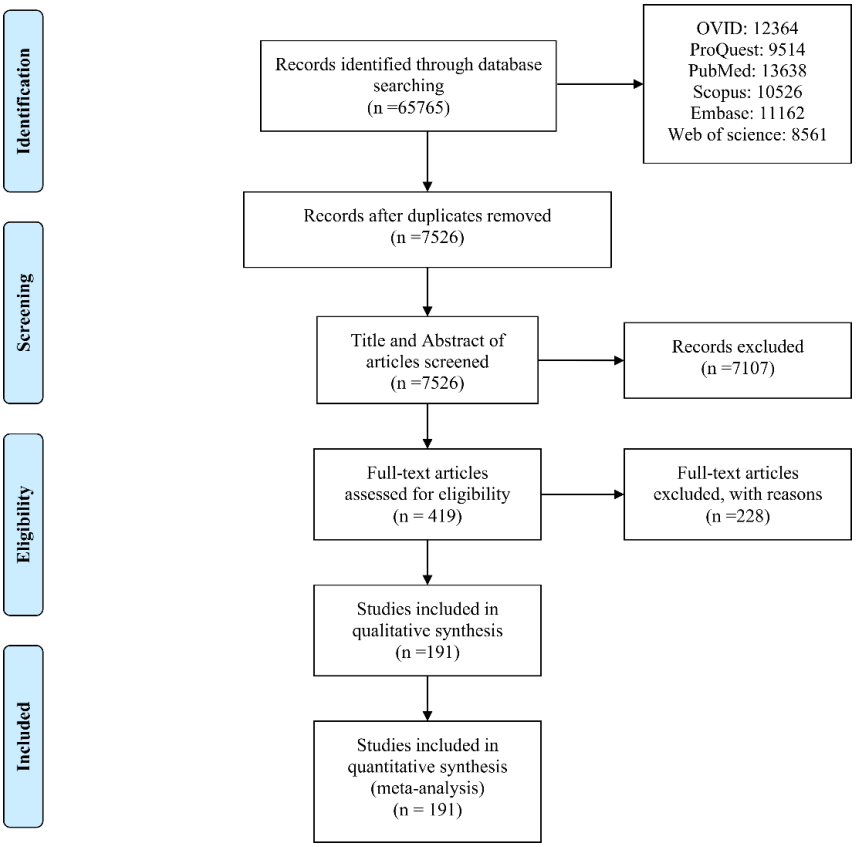

Figure 1. Flow chart of systematic review.

Table 1. Characteristics of studies incidence of type 1 diabetes

Study	Year	Country	Continent	Sample size	Incidence per 100
Abduljabbar et al[4]	2010	Saudi Arabia	Asia	1028	0.02752
Abdul-Rasoul et al[5]	2002	Kuwait	Asia	760	0.02018
Abellana et al[6]	2009	Spain	Europe	448	0.0118
Ajlouni et al[7]	1999	Jordan	Asia	123	0.0032
				107	0.0028
				138	0.0036
Alaghehbandan et al[8]	2006	Canada	USA	716	0.019
Alemu et al[9]	2009	Ethiopia	Africa	81	0.0021
Algert CS et al[10]	2009	Australia	Asia	605	0.016
Altobelli et al[11]	1998	Italy	Europe	355	0.00934
Arpi et al[12]	2002	Catania	Europe	470	0.01238
Aschner et al[13]	2014	America	USA	279	0.00731
Bahíllo et al[14]	2007	Spain	Europe	835	0.02222
Barat et al[15]	2008	French	Europe	510	0.01347
Battelino and Kržišnik[16]	1998	Slovenia	Europe	305	0.008
Berhan et al[17]	2011	Sweden	Europe	1612	0.0439
Bessaoud et al[18]	1990	Algeria	Africa	168	0.0044
Bizzarri et al[19]	2010	Italy	Europe	593	0.01568
Blanchard et al[20]	1997	Canada	USA	768	0.0204
Blumenfeld et al[21]	2014	Asia	Asia	433	0.0114
Bratina et al[22]	2001	Bosnia and Herzegovina	Europe	325	0.00854
Bruno et al[23]	1990	Italy	Europe	259	0.00678
Bruno et al[24]	1993	Italy	Europe	256	0.0067
Bruno et al[25]	1997	Italy	Europe	282	0.00739
Bruno et al[26]	2001	Italy	Europe	297	0.00778
Bruno et al[27]	2009	Italy	Europe	354	0.0093
Bruno et al[28]	2010	Italy	Europe	465	0.01226
Bruno et al[29]	2013	Italy	Europe	1644	0.0448
Calle-Pascual et al[30]	1993	Spain	Europe	565	0.01493

Table 1. Continued

Study	Year	Country	Continent	Sample size	Incidence per 10000
Calori et al[31]	1990	Italy	Europe	253	0.00663
Campbell-Stokes and Taylor[32]	2005	New Zealand	Europe	675	0.0179
Cardwell et al[33]	2006	Ireland	Europe	925	0.0247
Carrasco et al[34]	1996	Chile	USA	90	0.00236
Carrasco et al[35]	2006	Chile	USA	251	0.00658
Carrasco et al[36]	2006	Chile	USA	154	0.00402
Casu et al[37]	2004	Sardinia	Europe	1433	0.0388
Cherubini et al[38]	1994	Italy	Europe	309	0.0081
Chong et al[39]	2007	Australia	Asia	731	0.0194
Cinek et al[40]	2000	Czech Republic	Europe	384	0.0101
Cinek et al[41]	2003	Czech Republic	Europe	444	0.0117
Compés et al[42]	2013	Spain	Europe	723	0.0192
Cotellessa et al[43]	2003	Italy	Europe	476	0.01256
Crow et al[44]	1991	England	Europe	560	0.0148
				508	0.0134
Dabelea et al[45]	2009	Navajo nation	USA	86	0.00224
				841	0.0224
				1452	0.03934
Dacou-Voutetakis et al[46]	1995	Greece	Europe	239	0.00625
Demirbilek et al[47]	2013	Turkey	Asia	275	0.0072
Derraik et al[48]	2012	New Zealand	Europe	845	0.0225
Dziatkowiak et al[49]	2002	Poland	Europe	316	0.0083
				244	0.0064
				301	0.0079
Ehehalt et al[50]	2012	Europe	Europe	579	0.0153
Ehehalt et al[51]	2009	Italy	Europe	560	0.0148
Ehehalt et al[52]	2012	Europe	Europe	579	0.0153
El-Ziny et al[53]	2014	Egypt	Africa	119	0.0031
Feltbower et al[54]	2002	UK	Europe	493	0.013
Ferreira et al[55]	1993	Brazil	USA	290	0.0076
Forga et al[56]	2013	Spain	Europe	331	0.0087
Formosa et al[57]	2012	Malta	Africa	821	0.02186
Frazer De Llado et al[58]	1998	Puerto Rico	USA	679	0.018
Frongia et al[59]	1997	Italy	Europe	1411	0.0382
Gardner et al[60]	1997	USA	USA	701	0.0186
Charkaluk et al[61]	2002	France	Europe	364	0.00958
Giralt et al[62]	2001	Spain	Europe	973	0.026
Goday et al[63]	1992	Spain	Europe	407	0.0107
Gong et al[64]	2013	China	Asia	56	0.00145
Gopinath et al[65]	2008	Sweden	Europe	914	0.02438
Gorham et al[66]	1993	USA	USA	801	0.0213
Grabauskas et al[67]	1991	Lithuania	Europe	256	0.0067
Green and Patterson[68]	2001	Hungary	Europe	686	0.0182
Harjutsalo et al[69]	2008	Finland	Europe	1577	0.0429
Harjutsalo et al[70]	2013	Finland	Europe	2264	0.0629
Huen et al[71]	2000	Hong Kong	Asia	54	0.0014
Jarosz-Chobot et al[72]	2010	Poland	Europe	375	0.00987
Jarosz-Chobot et al[73]	2011	Poland	Europe	388	0.0102
Ji et al[74]	2010	Sweden	Europe	27	0.00071
Kadiki and Moawad[75]	1994	Libya	Africa	335	0.0088
Kadiki et al[76]	1996	Libya	Africa	343	0.009
Karvonen et al[77]	1996	Finland	Europe	1319	0.0356
Karvonen et al[78]	2000	China & Venezuela	Asia	4	0.0001
Karvonen et al[79]	1997	Finland	Europe	1507	0.0409
Kida et al[80]	1999	Japan	Asia	58	0.0015
Koton[81]	2007	Asia	Asia	305	0.008
Kulaylat and Narchi[82]	2000	Saudi Arabia	Asia	437	0.0115

Table 1. Continued

Study	Year	Country	Continent	Sample size	Incidence per 10000
Lammi et al[83]	2007	Finland	Europe	601	0.0159
Larenas et al[84]	1996	Chile	USA	49	0.00127
Lawrence et al[85]	2014	USA	USA	914	0.0244
Legault and Polychronakos[86]	2006	Canada	USA	568	0.015
Libman et al[87]	1998	USA	USA	631	0.0167
Lin et al[88]	2014	Taiwan	Asia	128	0.00334
Lipman[89]	1993	USA	USA	494	0.01302
Lipman et al[90]	2002	USA	USA	504	0.0133
Lipman et al[91]	2006	USA	USA	560	0.0148
Lipman et al[92]	2013	USA	USA	642	0.017
Lipton et al[93]	2002	USA	USA	575	0.0152
Lisbôa et al[94]	1998	Brazil	USA	455	0.012
Li et al[95]	2000	China	Asia	22	0.00056
Lora-Gómez et al[96]	2005	Spain	Europe	635	0.0168
Mamoulakis et al[97]	2003	Crete	Europe	233	0.0061
Martinucci et al[98]	2002	Belarus	Europe	176	0.0046
Mauny et al[99]	2005	France	Europe	230	0.00603
Mayer-Davis et al[100]	2009	USA	USA	594	0.0157
Mazzella et al[101]	1994	Italy	Europe	445	0.01172
Metcalfe and Baum[102]	1991	Britain	Europe	512	0.0135
Michalková et al[103]	2004	Slovakia	Europe	529	0.01396
Morales-Pérez et al[104]	2000	Spain	Europe	485	0.0128
Muiña et al[105]	2012	Spain	Europe	1031	0.0276
Muntoni et al[106]	1992	Sardinia	Europe	911	0.0243
Muntoni et al[107]	1997	Italy	Europe	1255	0.0338
Neu et al[108]	1997	German	Europe	440	0.0116
Neu et al[109]	2001	Europe	Europe	474	0.0125
Newhook et al[110]	2004	Canada	USA	1331	0.03593
Newhook et al[111]	2008	Canada	USA	1300	0.03508
Newhook et al[112]	2012	Canada	USA	1394	0.0377
Ostrauskas et al[113]	2011	Lithuania	Europe	316	0.0083
Patterson et al[114]	2000	Macedonia	Europe	123	0.0032
Patterson et al[115]	2001	Finland	Europe	1482	0.0402
Peter[116]	2007	Bahamas	USA	384	0.0101
Pinelli et al[117]	1998	Italy	Europe	407	0.0107
Pishdad[118]	2005	Iran	Asia	120	0.00314
Podar et al[119]	1992	Estonia	Europe	448	0.0118
Polanska et al[120]	2014	Poland	Europe	452	0.01192
Prisco et al[121]	1996	Italy	Europe	232	0.00607
Pronina et al[122]	2008	Moscow	Europe	489	0.0129
Pundziute-Lyckå et al[123]	2003	Lithuania	Europe	361	0.0095
				263	0.0069
Radosevic et al[124]	2013	Bosnia and Herzegovina	Europe	286	0.0075
		Slovenia		474	0.0125
Ramachandran et al[125]	1996	India	Asia	399	0.0105
Rami et al[126]	2001	Austria	Asia	342	0.00899
Rangasami et al[127]	1997	Scotland	Europe	896	0.0239
Serrano Río et al[128]	1990	Spain	Europe	429	0.0113
Roche et al[129]	2002	Ireland	Europe	627	0.0166
Rosenbauer et al[130]	1999	Europe	Europe	309	0.0081
Aude Rueda et al[131]	1998	Mexico	USA	44	0.00115
Rytkönen et al[132]	2003	Finland	Europe	1383	0.0374
Samardzic et al[133]	2010	Montenegro	Europe	508	0.0134
Samuelsson et al[134]	1994	Sweden	Europe	944	0.0252
Santos et al[135]	2001	Chile	USA	157	0.00411
Sasaki and Okamoto[136]	1992	Japan	Asia	64	0.00168
				77	0.002

Table 1. Continued

Study	Year	Country	Continent	Sample size	Incidence per 10000
Schober et al[137]	1995	Australia	Asia	301	0.0079
Schober et al[138]	2009	Austria	Asia	694	0.0184
Schoenle et al[139]	2001	Switzerland	Europe	399	0.0105
Scott et al[140]	1992	New Zealand	Europe	482	0.0127
Sebastiani et al[141]	1996	Italy	Europe	301	0.0079
Sella et al[142]	2010	Asia	Asia	481	0.01269
Sereday et al[143]	1994	Argentina	USA	2694	0.0759
Shaltout et al[144]	2002	Kuwait	Asia	757	0.0201
Shamis et al[145]	1997	Asia	Asia	278	0.0073
López Siguero et al[146]	1997	Malaga	Europe	541	0.0143
Sipetic et al[147]	2013	Serbia	Europe	395	0.0104
Skordis and Hadjiloizou[148]	1997	Greece	Europe	399	0.0105
Skordis et al[149]	2002	Greece	Europe	430	0.01132
Skordis et al[150]	2012	Cyprus	Asia	473	0.01246
Skrivarhaug et al[151]	2014	Norway	Europe	1215	0.0327
Smith et al[152]	2007	USA	USA	683	0.0181
Staines et al[153]	1993	UK	Europe	519	0.0137
Staines et al[154]	1997	Pakistan	Asia	39	0.00102
Stipancic et al[155]	2008	Croatia	Europe	338	0.00887
Svensson et al[156]	2002	Denmark	Europe	731	0.0194
Svensson et al[157]	2008	Denmark	Europe	827	0.022
Swai et al[158]	1993	Tanzania	Africa	58	0.0015
Tahirovic et al[159]	2007	Bosnia and Herzegovina	Europe	271	0.0071
Taplin et al[160]	2005	New South Wales	Asia	786	0.0209
Teeäär et al[161]	2009	Estonia	Europe	649	0.0172
Thunander et al[162]	2008	Sweden	Europe	1397	0.0378
Torffvit et al[163]	2007	Sweden	Europe	482	0.0127
Toth et al[164]	1997	Canada	USA	962	0.0257
Toumba et al[165]	2007	Cyprus	Asia	452	0.0119
Tran et al[166]	2014	Australia	Asia	827	0.022
Tuchinda et al[167]	2002	Thailand	Asia	63	0.00165
Tull et al[168]	1991	Virgin Islands	USA	286	0.0075
Tuomilehto et al[169]	1991	Finland	Europe	1219	0.0328
Tuomilehto-Wolf et al[170]	1991	Estonia	Europe	407	0.0107
Tuomilehto et al[171]	1992	Finland	Europe	1305	0.0352
Tuomilehto et al[172]	1992	Finland	Europe	1031	0.0276
Tuomilehto et al[173]	1993	Mauritius	Africa	81	0.0021
Tuomilehto et al[174]	199	Finland	Europe	1369	0.037
Tzaneva et al[175]	1998	Bulgaria	Europe	241	0.00632
Vandewalle et al[176]	1997	Belgium	Europe	448	0.0118
Vehik[177]	2007	Colorado	USA	560	0.0148
Verge et al[178]	1994	Australia	Asia	549	0.0145
Vichi et al[179]	2014	Italy	Europe	508	0.0134
Vlajinac et al[180]	1995	Serbia	Europe	294	0.0077
Vos et al[181]	1996	Netherland	Europe	753	0.02
Wadsworth et al[182]	1995	England	Europe	354	0.0093
Washington et al[183]	2012	USAVirgin Islands	USA	579	0.0153
Willis et al[184]	2002	New Zealand	Europe	757	0.02012
Wong[185]	1994	China	Asia	65	0.0017
Wong et al[186]	1993	Hong Kong	Asia	77	0.002
Yang et al[187]	1998	China	Asia	18	0.00048
Yang et al[188]	2005	China	Asia	18	0.00047
Zalutskaya et al[189]	2004	Gomel area	Europe	300	0.00786
		Minsk area		127	0.00332
Zhao et al[190]	1999	England	Europe	564	0.0149
Zhao et al[191]	2014	China	China	119	0.0031
Zubkiewicz-Kucharska and Noczyńska[192]	2010	Poland	Europe	471	0.01241

Table 2. Prevalence and incidence of type 1 diabetes in the world

	Prevalence Per 10 000	Incidence Per 100 000
World	7.5	15
Asia	3.8	15
Africa	5.2	8
Europe	12.5	15
America	5.0	20

Table 3. Characteristics of studies prevalence of type 1 diabetes

Study	Country	Prevalence Per 100 000
Akazawa[193]	Japan	10
Akesen et al[194]	Turkey	67
Al-Herbish et al[195]	Saudi Arabia	109.5
Bessaoud et al[18]	Algeria	27
Dabelea et al[45]	Navajo nation	18
Dabelea et al[196]	USA	148
Ehehalt et al[51]	Italy	110
Elamin et al[197]	Sudan	95
El-Ziny et al[53]	Egypt	26.8
Eriksson et al[198]	Finland	270
Evans et al[199]	Scotland	220
Frongia et al[59]	Italy	459
Gujral et al[201]	UK	75
Jorge et al[202]	Portugal	128
Kemper et al[203]	USA	167
Mayer-Davis et al[100]	USA	57
Moussa et al[204]	Kuwait	269.9
Ostrauskas[205]	Lithuania	80.64
Ostrauskas and Žalinkevičius[206]	Lithuania	70.23
Peter et al[116]	Bahamas	31
Pettitt et al[207]	USA	193
Ramachandran et al[208]	India	26
Rangasami et al[127]	Scotland	150
Scott et al[140]	New Zealand	115
López Siguero et al[146]	Malaga	78
Soliman et al[209]	Oman	13.25
Songini et al[210]	Sardinia	119
Wong[185]	China	8.3
Wu et al[211]	New Zealand	227

(Incidence = 0.015 per 100 population, 95% CI = 0.010 to 0.021 per 100 population, $P < 0.001$), and the prevalence of type 1 diabetes was 3.8 per 10 000 people, which was statistically significant (Prevalence = 0.038%, 95% CI = 0.017% to 0.084%, $P < 0.001$). Figures 2A and 2B show the forest plot of prevalence and incidence of type 1 diabetes in Asia.

Prevalence and incidence of type 1 diabetes in Africa

Prevalence and incidence of type 1 diabetes were extracted from meta-analysis studies. In type 1 diabetes incidence, the heterogeneity between studies in the meta-analysis was significant ($Q = 23.79$; $df = 6$; $P < 0.001$; $I^2 = 74.78$) and in the prevalence of diabetes 1, the heterogeneity was significant too, ($Q = 46.32$; $df = 1$; $P < 0.001$; $I^2 = 97.84$). The incidence of type 1 diabetes in Africa was 8 per 100 000 population, which was statistically significant (Incidence = 0.008 per 100 population, 95% CI = 0.003 to 0.021 per 100 population, $P < 0.001$), and the prevalence of type 1 diabetes was 5.2 per 10 000 people, which was statistically significant (prevalence = 0.052%, 95% CI: 0.015% to 0.168%, $P < 0.001$). Figures 3A and 3B show the forest plot of prevalence and incidence of type 1 diabetes in Africa.

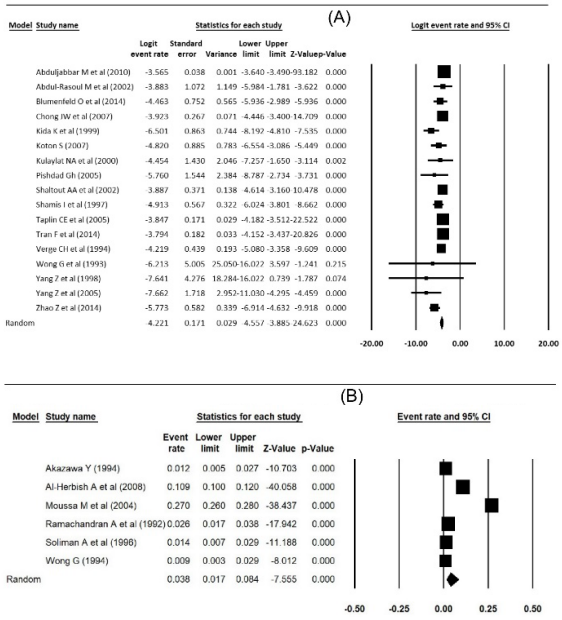

Figure 2. (A) Incidence and (B) prevalence of type 1 diabetes in Asia.

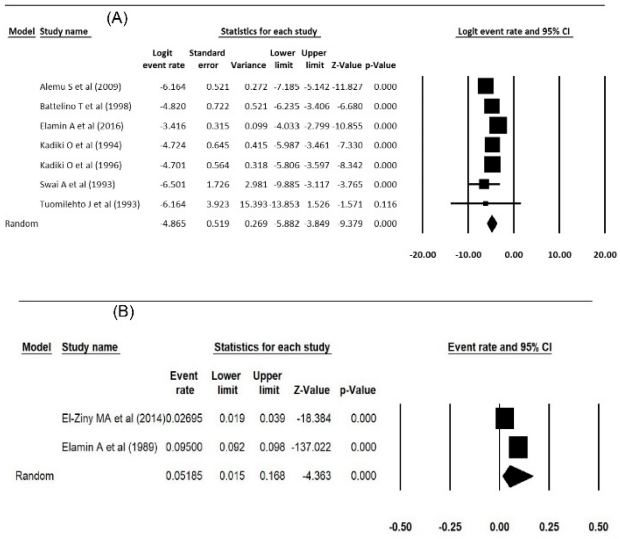

Figure 3. (A) Incidence and (B) prevalence of type 1 diabetes in Africa.

Prevalence and incidence of type 1 diabetes in Europe

Prevalence and incidence of type 1 diabetes were extracted from meta-analysis studies. In type 1 diabetes incidence, the heterogeneity between studies in the meta-analysis was significant (Q = 895.56, *df* = 96, *P* < 0.001, I^2 = 89.28). Moreover, in the prevalence of diabetes 1, the heterogeneity between studies was significant, (Q = 5493, *df* = 14, *P* < 0.001, I^2 = 99.74). The incidence of type 1 diabetes in Europe was 15 per 100 000 population, which was statistically significant (Incidence = 0.015 per 100 population, 95% CI = 0.013 to 0.018 per 100 population, *P* < 0.001), and the prevalence of type 1 diabetes was 12.5 per 10 000 people, which was statistically significant (Prevalence = 0.125%, 95% CI = 0.086% to 0.177%, *P* < 0.001). Figures 4 and 5 show the forest plot of prevalence and incidence of type 1 diabetes in Europe.

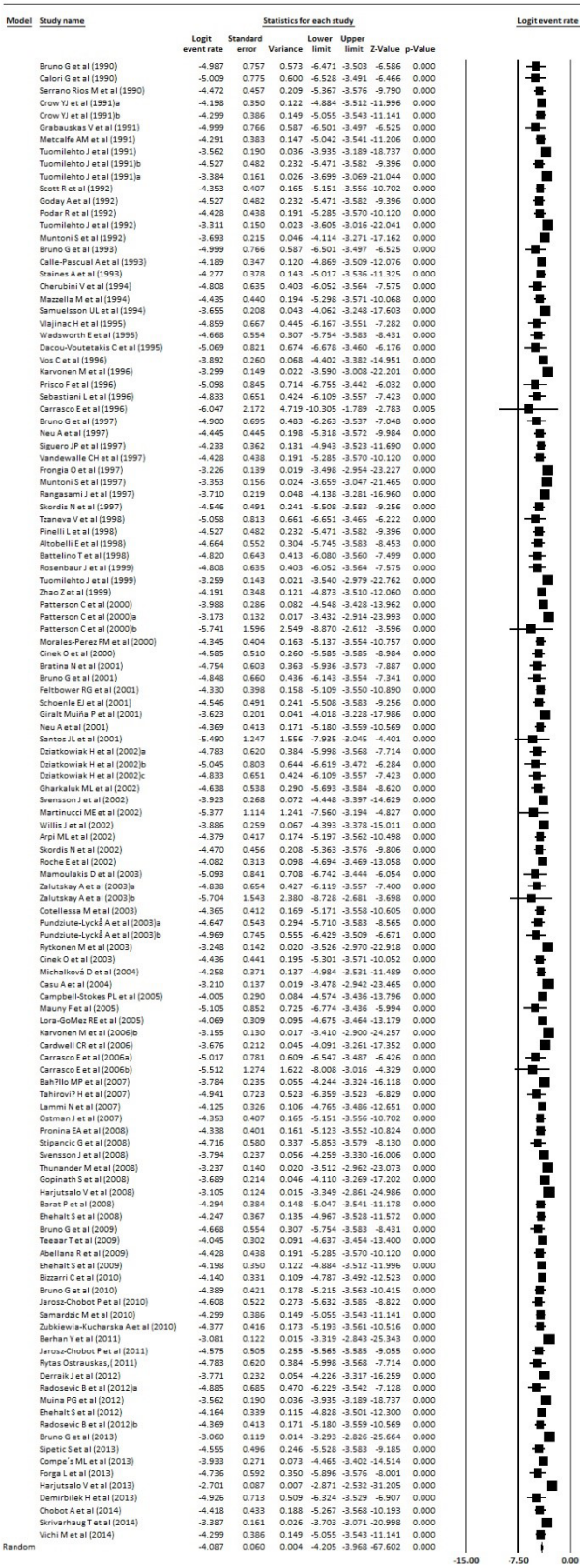

Figure 4. Incidence of type 1 diabetes in Europe.

Prevalence and incidence of type 1 diabetes in America

Prevalence and incidence of type 1 diabetes were extracted from meta-analysis studies. In type 1 diabetes incidence, the heterogeneity between studies in the meta-analysis was significant (Q = 47.74, *df* = 15, *P* < 0.001, I^2 = 68.58). In the prevalence of type 1 diabetes, the heterogeneity between studies was also significant (Q = 871.9, df = 7, *P* < 0.001, I^2 = 99.19). The incidence of type 1 diabetes in America was 20 per 100 000 population, which was statistically significant (Incidence = 0.020 per 100 population, 95% CI = 0.017 to 0.023 per 100 population, *P* < 0.001), and the prevalence of type 1 diabetes was 5 per 10 000 people, which was statistically significant (Prevalence = 0.050%, 95% CI = 0.036% to 0.070%, *P* < 0.001). Figures 6A and 6B show the forest plot of prevalence and incidence of type 1 diabetes in America. A sensitivity analysis was done for Incidence of type 1 diabetes in America based on excluding studies with too wide CIs. Sensitivity analysis's results show that the incidence of type 1 diabetes in America is 19 per 100 000 population, which is statistically significant (Incidence = 0.019 per 100 population, 95% CI = 0.016 to 0.022 per 100 population, *P* < 0.001).

Prevalence and incidence of type 1 diabetes in the world

Prevalence and incidence of type 1 diabetes were extracted from meta-analysis studies. In type 1 diabetes incidence, the heterogeneity between studies in the meta-analysis was significant (Q = 1020.30, df = 137, *P* < 0.001, I^2 = 86.57) and in the prevalence of diabetes 1, the heterogeneity was significant too, (Q = 111355, df = 30, *P* < 0.001, I^2 = 99.97). The incidence of type 1 diabetes in world was 15 per 100 000 population, which was statistically significant

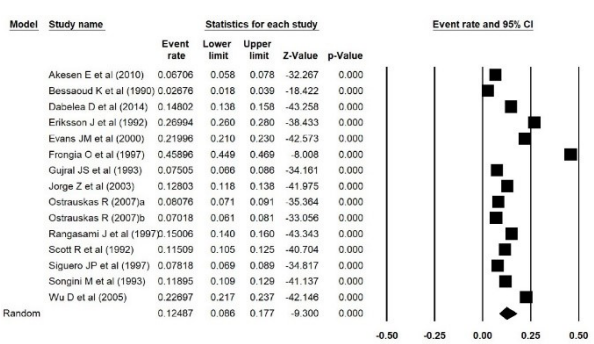

Figure 5. Prevalence of type 1 diabetes in Europe.

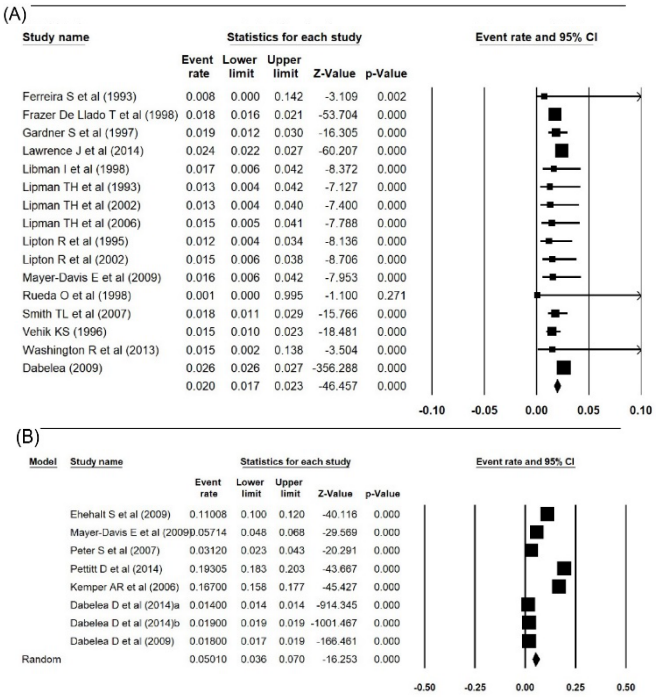

Figure 6. (A) Incidence and (B) prevalence of type 1 diabetes in America.

(Incidence = 0.015 per 100 population, 95% CI = 0.013 to 0.017 per 100 population, $P < 0.001$) (data not shown). The prevalence of type 1 diabetes was 7.5 per 10 000 people, which was statistically significant (prevalence = 0.075%, 95% CI = 0.051% to 0.11%, $P < 0.001$). Figure 7 shows the forest plot of prevalence of type 1 diabetes in the world.

Publication bias

In order to assess the publication bias, Eggers Regression test was used. Based on the results, the publication bias between studies was not significant.

Meta-Regression

Meta-regression was used to determine the effect of time on type 1 diabetes incidence. The results showed that the incidence of type 1 diabetes has increased over time. The meta-regression plot is shown in Figure 8.

Discussion

The global trend of increasing prevalence of type 1 diabetes, with multiple etiologies, operates through multiple mechanisms. In the present study, data were extracted from 191 articles between 1990 and 2019. The results showed that the incidence of type 1 diabetes in continental subgroups (Asia, Africa, Europe, and America) was 15 per 100 000, 8 per 100 000, 15 per 100 000 and 20 per 100, respectively. Also, the global prevalence of continental subtypes of type 1 diabetes in the above regions was, 3.8 per 10 000, 5.2 per 10 000, 12.5 per 10 000, and 5.0 per 10 000, respectively.

Relative differences between obtained results and previous statistics may be due to different research time periods and new global population status. Especially in recent years (social, political and economic migration), the changing global climate coupled with new policies and sanctions that have led to poorer middle-income and low-income countries.[212]

The pathogenesis of type 2 diabetes is known, which is associated with different genes and the involvement of multiple factors. Type 2 diabetes can be prevented and treated by removing or reducing these factors. Most of the warnings of national and international health bodies and diabetes associations are based on lifestyle changes and stress reduction that can prevent diabetes.[213]

But in type 1 diabetes, that make up 5 to 15 percent of diabetics and often involve children, Prevention ways have not yet been defined. However, screening of type 1

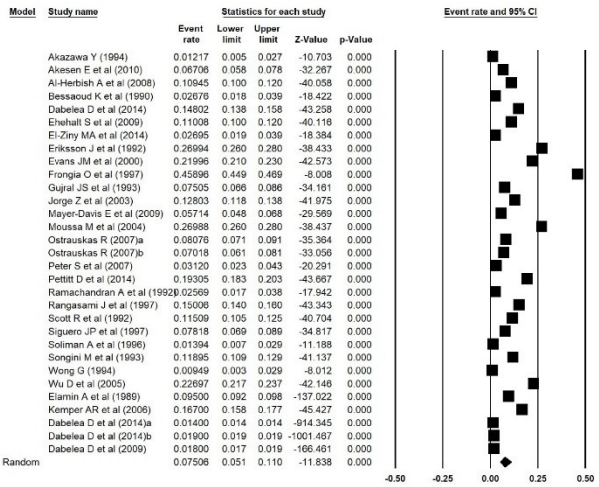

Figure 7. Prevalence of type 1 diabetes in the world.

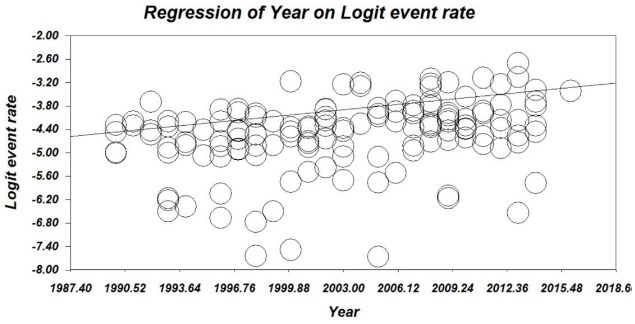

Figure 8. The meta-regression plot.

diabetes in prone families in relation to autoantibodies has recently been proposed. Also, clinical studies on the prevention of type 1 diabetes have been conducted.214

If one foot was amputated every 30 seconds, today it's every 15 seconds. Need for dialysis equipment will increase. The CCU and ICU beds will be full of stroke and myocardial infarction patients. The population of the blind increases and unfortunately, new, effective, and less complicated treatments become more expensive.[215]

The disease shows a significant increase in glucose and possibly DKA. These patients definitely need insulin due to the pathogenesis of insulin deficiency. Manufacturing and production of insulin (traditional insulins and analog insulins) and insulin pumps, despite being inexpensive in producing countries, is shipped to low- and middle-income countries for high prices which is a major problem for the managing of type 1 diabetes patients. Certainly, uncontrolled hyperglycemia in type 1 diabetic patients will make all the problems more severe.[216]

Limitations

One of the limitations of the study was the poor quality of some articles and, despite a careful search, the lack of access to some of the full text of the published articles.

Conclusion

According to the results, the incidence and prevalence of type 1 diabetes are increasing in the world. As a result, insulin will be difficult to access and afford, especially in underdeveloped and developing countries. Thus, warnings about this can help international organizations and countries to plan for preventive measures.

Ethical approval

This research was approved by the Local Ethics Committee with No. 61701.

Competing interests

The authors declare that they have no competing interests.

Funding

This article was supported by the Research Center for Evidence-Based Medicine, and the Research Vice-Chancellor of Tabriz University of Medical Sciences.

Authors' contributions

Concept: MM. Study design: MSH and TA. Systematic search: NV. Critical reviews: MM and TA. Data extraction: MSH and MGH. Data analysis: MGH and HHF. Writing: NV, TA and MM. All authors had primary responsibility for the final content of the manuscript and read and approved the final manuscript.

Acknowledgments

Special thanks to the Research Vice-Chancellor of Tabriz University of Medical Sciences for financial support for this study.

Supplementary Materials

Supplementary file 1 contains search strategy.

References

1. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010;33 Suppl 1:S62-9. doi: 10.2337/dc10-S062.
2. Davis IC, Ahmadizadeh I, Randell J, Younk L, Davis SN. Understanding the impact of hypoglycemia on the cardiovascular system. Expert Rev Endocrinol Metab. 2017;12(1):21-33. doi: 10.1080/17446651.2017.1275960.
3. Gale EA. The rise of childhood type 1 diabetes in the 20th century. Diabetes. 2002;51(12):3353-61. doi: 10.2337/diabetes.51.12.3353.
4. Abduljabbar MA, Aljubeh JM, Amalraj A, Cherian MP. Incidence trends of childhood type 1 diabetes in eastern Saudi Arabia. Saudi Med J. 2010;31(4):413-8.
5. Abdul-Rasoul M, Al-Qattan H, Al-Haj A, Habib H, Ismael A. Incidence and seasonal variation of type 1 diabetes in children in Farwania area, Kuwait (1995-1999). Diabetes Res Clin Pract. 2002;56(2):153-7. doi: 10.1016/s0168-8227(01)00371-0.
6. Abellana R, Ascaso C, Carrasco JL, Castell C, Tresserras R. Geographical variability of the incidence of type 1 diabetes in subjects younger than 30 years in Catalonia, Spain. Med Clin (Barc). 2009;132(12):454-8. doi: 10.1016/j.medcli.2008.10.042.
7. Ajlouni K, Qusous Y, Khawaldeh AK, Jaddou H, Batiehah A, Ammari F, et al. Incidence of insulin-dependent diabetes mellitus in Jordanian children aged 0-14 y during 1992-1996. Acta Paediatr Suppl. 1999;88(427):11-3.
8. Alaghehbandan R, Collins KD, Newhook LA, MacDonald D. Childhood type 1 diabetes mellitus in Newfoundland and Labrador, Canada. Diabetes Res Clin Pract. 2006;74(1):82-9. doi: 10.1016/j.diabres.2006.03.001.
9. Alemu S, Dessie A, Seid E, Bard E, Lee PT, Trimble ER, et al. Insulin-requiring diabetes in rural Ethiopia: should we reopen the case for malnutrition-related diabetes? Diabetologia. 2009;52(9):1842-5. doi: 10.1007/s00125-009-1433-5.
10. Algert CS, McElduff A, Morris JM, Roberts CL. Perinatal risk factors for early onset of type 1 diabetes in a 2000-2005 birth cohort. Diabet Med. 2009;26(12):1193-7. doi: 10.1111/j.1464-5491.2009.02878.x.

11. Altobelli E, Chiarelli F, Valenti M, Verrotti A, Tumini S, Di Orio F. Incidence of insulin-dependent diabetes mellitus (0-14 years) in the Abruzzo Region, Italy, 1990-1995: results from a population-based register. J Pediatr Endocrinol Metab. 1998;11(4):555-62. doi: 10.1515/jpem.1998.11.4.555.
12. Arpi ML, Fichera G, Mancuso M, Lucenti C, Italia S, Tomaselli L, et al. A ten-year (1989-1998) perspective study of the incidence of type 1 diabetes in the district of Catania (Sicily) in a 0-14 year age group. J Endocrinol Invest. 2002;25(5):414-9. doi: 10.1007/bf03344030.
13. Aschner P, Aguilar-Salinas C, Aguirre L, Franco L, Gagliardino JJ, de Lapertosa SG, et al. Diabetes in South and Central America: an update. Diabetes Res Clin Pract. 2014;103(2):238-43. doi: 10.1016/j.diabres.2013.11.010.
14. Bahíllo MP, Hermoso F, Ochoa C, García-Fernández JA, Rodrigo J, Marugán JM, et al. Incidence and prevalence of type 1 diabetes in children aged <15 yr in Castilla-Leon (Spain). Pediatr Diabetes. 2007;8(6):369-73. doi: 10.1111/j.1399-5448.2007.00255.x.
15. Barat P, Valade A, Brosselin P, Alberti C, Maurice-Tison S, Lévy-Marchal C. The growing incidence of type 1 diabetes in children: the 17-year French experience in Aquitaine. Diabetes Metab. 2008;34(6 Pt 1):601-5. doi: 10.1016/j.diabet.2008.06.002.
16. Battelino T, Kržišnik C. Incidence of type 1 diabetes mellitus in children in Slovenia during the years 1988-1995. Acta Diabetol. 1998;35(2):112-4. doi: 10.1007/s005920050115.
17. Berhan Y, Waernbaum I, Lind T, Möllsten A, Dahlquist G. Thirty years of prospective nationwide incidence of childhood type 1 diabetes: the accelerating increase by time tends to level off in Sweden. Diabetes. 2011;60(2):577-81. doi: 10.2337/db10-0813.
18. Bessaoud K, Boudraa G, Deschamps I, Hors J, Benbouabdallah M, Touhami M. Epidemiology of juvenile insulin-dependent diabetes in Algeria (Wilaya of Oran). Rev Epidemiol Sante Publique. 1990;38(2):91-9.
19. Bizzarri C, Patera PI, Arnaldi C, Petrucci S, Bitti ML, Scrocca R, et al. Incidence of type 1 diabetes has doubled in Rome and the Lazio region in the 0- to 14-year age-group: a 6-year prospective study (2004-2009). Diabetes Care. 2010;33(11):e140. doi: 10.2337/dc10-1168.
20. Blanchard JF, Dean H, Anderson K, Wajda A, Ludwig S, Depew N. Incidence and prevalence of diabetes in children aged 0-14 years in Manitoba, Canada, 1985-1993. Diabetes Care. 1997;20(4):512-5. doi: 10.2337/diacare.20.4.512.
21. Blumenfeld O, Dichtiar R, Shohat T. Trends in the incidence of type 1 diabetes among Jews and Arabs in Israel. Pediatr Diabetes. 2014;15(6):422-7. doi: 10.1111/pedi.12101.
22. Bratina NU, Tahirović H, Battelino T, Krzisnik C. Incidence of childhood-onset type I diabetes in Slovenia and the Tuzia region (Bosnia and Herzegovina) in the period 1990-1998. Diabetologia. 2001;44 Suppl 3:B27-31. doi: 10.1007/pl00002949.
23. Bruno G, Merletti F, Pisu E, Pastore G, Marengo C, Pagano G. Incidence of IDDM during 1984-1986 in population aged less than 30 yr. Residents of Turin, Italy. Diabetes Care. 1990;13(10):1051-6. doi: 10.2337/diacare.13.10.1051.
24. Bruno G, Merletti F, Vuolo A, Pisu E, Giorio M, Pagano G. Sex differences in incidence of IDDM in age-group 15-29 yr. Higher risk in males in province of Turin, Italy. Diabetes Care. 1993;16(1):133-6. doi: 10.2337/diacare.16.1.133.
25. Bruno G, Merletti F, De Salvia A, Lezo A, Arcari R, Pagano G. Comparison of incidence of insulin-dependent diabetes mellitus in children and young adults in the province of Turin, Italy, 1984-91. Piedmont Study Group for Diabetes Epidemiology. Diabet Med. 1997;14(11):964-9. doi: 10.1002/(sici)1096-9136(199711)14:11<964::aid-dia493>3.0.co;2-p.
26. Bruno G, Merletti F, Biggeri A, Cerutti F, Grosso N, De Salvia A, et al. Increasing trend of type I diabetes in children and young adults in the province of Turin (Italy). Analysis of age, period and birth cohort effects from 1984 to 1996. Diabetologia. 2001;44(1):22-5. doi: 10.1007/s001250051575.
27. Bruno G, Novelli G, Panero F, Perotto M, Monasterolo F, Bona G, et al. The incidence of type 1 diabetes is increasing in both children and young adults in Northern Italy: 1984-2004 temporal trends. Diabetologia. 2009;52(12):2531-5. doi: 10.1007/s00125-009-1538-x.
28. Bruno G, Maule M, Merletti F, Novelli G, Falorni A, Iannilli A, et al. Age-period-cohort analysis of 1990-2003 incidence time trends of childhood diabetes in Italy: the RIDI study. Diabetes. 2010;59(9):2281-7. doi: 10.2337/db10-0151.
29. Bruno G, Maule M, Biggeri A, Ledda A, Mannu C, Merletti F, et al. More than 20 years of registration of type 1 diabetes in Sardinian children: temporal variations of incidence with age, period of diagnosis, and year of birth. Diabetes. 2013;62(10):3542-6. doi: 10.2337/db12-1771.
30. Calle-Pascual AL, Vicente A, Martin-Alvarez PJ, Yuste E, de Matias J, Calle JR, et al. Estimation of the prevalence of diabetes mellitus diagnosed, and incidence of type 1 (insulin-dependent) diabetes mellitus in the Avila Health Care region of Spain. Diabetes Res Clin Pract. 1993;19(1):75-81. doi: 10.1016/0168-8227(93)90147-w.
31. Calori G, Gallus G, Garancini P, Repetto F, Micossi P. Identification of the cohort of type 1 diabetes presenting in Lombardy in 1983-84: a validated assessment. Diabet Med. 1990;7(7):595-9. doi: 10.1111/j.1464-5491.1990.tb01455.x.
32. Campbell-Stokes PL, Taylor BJ. Prospective incidence study of diabetes mellitus in New Zealand children aged 0 to 14 years. Diabetologia. 2005;48(4):643-8. doi: 10.1007/s00125-005-1697-3.
33. Cardwell CR, Carson DJ, Patterson CC. Higher incidence of childhood-onset type 1 diabetes mellitus in remote areas: a UK regional small-area analysis. Diabetologia. 2006;49(9):2074-7. doi: 10.1007/s00125-006-0342-0.
34. Carrasco E, Pérez-Bravo F, Santos JL, López G, Calvillán M, Wolff C, et al. One of the lowest validated incidence rates of insulin dependent diabetes mellitus in the Americas: Santiago, Chile. Diabetes Res Clin Pract. 1996;34 Suppl:S153-7. doi: 10.1016/s0168-8227(96)90023-6.
35. Carrasco E, Pérez-Bravo F, Dorman J, Mondragón A, Santos JL. Increasing incidence of type 1 diabetes in population from Santiago of Chile: trends in a period of 18 years (1986-2003). Diabetes Metab Res Rev. 2006;22(1):34-7. doi: 10.1002/dmrr.558.
36. Carrasco E, Angel B, Codner E, García D, Ugarte F, Bruzzone ME, et al. Type 1 diabetes mellitus incidence in Santiago, Chile. Analysis by counties in the period 2000-2004. Rev Med Chil. 2006;134(10):1258-64. doi: 10.4067/s0034-98872006001000007.
37. Casu A, Pascutto C, Bernardinelli L, Songini M. Type 1 diabetes among Sardinian children is increasing: the Sardinian diabetes register for children aged 0-14 years (1989-1999). Diabetes Care. 2004;27(7):1623-9. doi: 10.2337/diacare.27.7.1623.
38. Cherubini V, Cantarini M, Ravaglia E, Bartolotta E. Incidence of IDDM in the Marche region, Italy. Diabetes Care. 1994;17(5):432-5. doi: 10.2337/diacare.17.5.432.

39. Chong JW, Craig ME, Cameron FJ, Clarke CF, Rodda CP, Donath SM, et al. Marked increase in type 1 diabetes mellitus incidence in children aged 0-14 yr in Victoria, Australia, from 1999 to 2002. Pediatr Diabetes. 2007;8(2):67-73. doi: 10.1111/j.1399-5448.2007.00229.x.
40. Cinek O, Lánská V, Kolousková S, Sumník Z, Snajderová M, Rønningen KS, et al. Type 1 diabetes mellitus in Czech children diagnosed in 1990-1997: a significant increase in incidence and male predominance in the age group 0-4 years. Collaborators of the Czech Childhood Diabetes Registry. Diabet Med. 2000;17(1):64-9. doi: 10.1046/j.1464-5491.2000.00202.x.
41. Cinek O, Sumnik Z, Vavrinec J. Continuing increase in incidence of childhood-onset type 1 diabetes in the Czech Republic 1990-2001. Eur J Pediatr. 2003;162(6):428-9. doi: 10.1007/s00431-003-1211-1.
42. Compés ML, Feja C, Niño De Guzman E, Aguilar I, Conde S, Alonso JP, et al. Bayesian analysis of the geographical variation of type 1 diabetes mellitus in under 15 yr olds in northeast Spain, 1991-2009. Pediatr Diabetes. 2013;14(1):66-76. doi: 10.1111/j.1399-5448.2012.00892.x.
43. Cotellessa M, Barbieri P, Mazzella M, Bonassi S, Minicucci L, Lorini R. High incidence of childhood type 1 diabetes in Liguria, Italy, from 1989 to 1998. Diabetes Care. 2003;26(6):1786-9. doi: 10.2337/diacare.26.6.1786.
44. Crow YJ, Alberti KG, Parkin JM. Insulin dependent diabetes in childhood and material deprivation in northern England, 1977-86. BMJ. 1991;303(6795):158-60. doi: 10.1136/bmj.303.6795.158.
45. Dabelea D, DeGroat J, Sorrelman C, Glass M, Percy CA, Avery C, et al. Diabetes in Navajo youth: prevalence, incidence, and clinical characteristics: the SEARCH for Diabetes in Youth Study. Diabetes Care. 2009;32 Suppl 2:S141-7. doi: 10.2337/dc09-S206.
46. Dacou-Voutetakis C, Karavanaki K, Tsoka-Gennatas H. National data on the epidemiology of IDDM in Greece. Cases diagnosed in 1992. Hellenic Epidemiology Study Group. Diabetes Care. 1995;18(4):552-4. doi: 10.2337/diacare.18.4.552.
47. Demirbilek H, Özbek MN, Baran RT. Incidence of type 1 diabetes mellitus in Turkish children from the southeastern region of the country: a regional report. J Clin Res Pediatr Endocrinol. 2013;5(2):98-103. doi: 10.4274/Jcrpe.954.
48. Derraik JG, Reed PW, Jefferies C, Cutfield SW, Hofman PL, Cutfield WS. Increasing incidence and age at diagnosis among children with type 1 diabetes mellitus over a 20-year period in Auckland (New Zealand). PLoS One. 2012;7(2):e32640. doi: 10.1371/journal.pone.0032640.
49. Dziatkowiak H, Ciechanowska M, Wasikowa R, Symonides-ławecka A, Bieniasz J, Trippenbach-Dulska H, et al. Increase in the incidence of type 1 diabetes mellitus in children in three cities in Poland, 1987-1999. J Pediatr Endocrinol Metab. 2002;15(8):1153-60. doi: 10.1515/jpem.2002.15.8.1153.
50. Ehehalt S, Blumenstock G, Willasch AM, Hub R, Ranke MB, Neu A. Continuous rise in incidence of childhood type 1 diabetes in Germany. Diabet Med. 2008;25(6):755-7. doi: 10.1111/j.1464-5491.2008.02450.x.
51. Ehehalt S, Popovic P, Muntoni S, Muntoni S, Willasch A, Hub R, et al. Incidence of diabetes mellitus among children of Italian migrants substantiates the role of genetic factors in the pathogenesis of type 1 diabetes. Eur J Pediatr. 2009;168(5):613-7. doi: 10.1007/s00431-008-0808-9.
52. Ehehalt S, Dietz K, Willasch AM, Neu A. Prediction model for the incidence and prevalence of type 1 diabetes in childhood and adolescence: evidence for a cohort-dependent increase within the next two decades in Germany. Pediatr Diabetes. 2012;13(1):15-20. doi: 10.1111/j.1399-5448.2011.00799.x.
53. El-Ziny MA, Salem NA, El-Hawary AK, Chalaby NM, Elsharkawy AA. Epidemiology of childhood type 1 diabetes mellitus in Nile Delta, northern Egypt - a retrospective study. J Clin Res Pediatr Endocrinol. 2014;6(1):9-15. doi: 10.4274/Jcrpe.1171.
54. Feltbower RG, Bodansky HJ, McKinney PA, Houghton J, Stephenson CR, Haigh D. Trends in the incidence of childhood diabetes in south Asians and other children in Bradford, UK. Diabet Med. 2002;19(2):162-6. doi: 10.1046/j.1464-5491.2002.00691.x.
55. Ferreira SR, Franco LJ, Vivolo MA, Negrato CA, Simoes AC, Ventureli CR. Population-based incidence of IDDM in the state of São Paulo, Brazil. Diabetes Care. 1993;16(5):701-4. doi: 10.2337/diacare.16.5.701.
56. Forga L, Goñi MJ, Cambra K, Ibáñez B, Mozas D, Chueca M. [Differences by age and gender in the incidence of type 1 diabetes in Navarre, Spain (2009-2011)]. Gac Sanit. 2013;27(6):537-40. doi: 10.1016/j.gaceta.2012.12.016.
57. Formosa N, Calleja N, Torpiano J. Incidence and modes of presentation of childhood type 1 diabetes mellitus in Malta between 2006 and 2010. Pediatr Diabetes. 2012;13(6):484-8. doi: 10.1111/j.1399-5448.2011.00839.x.
58. Frazer de Llado TE, Gonzalez de Pijem L, Hawk B. Incidence of IDDM in children living in Puerto Rico. Puerto Rican IDDM Coalition. Diabetes Care. 1998;21(5):744-6. doi: 10.2337/diacare.21.5.744.
59. Frongia O, Mastinu F, Sechi GM. Prevalence and 4-year incidence of insulin-dependent diabetes mellitus in the province of Oristano (Sardinia, Italy). Acta Diabetol. 1997;34(3):199-205. doi: 10.1007/s005920050074.
60. Gardner SG, Bingley PJ, Sawtell PA, Weeks S, Gale EA. Rising incidence of insulin dependent diabetes in children aged under 5 years in the Oxford region: time trend analysis. The Bart's-Oxford Study Group. BMJ. 1997;315(7110):713-7. doi: 10.1136/bmj.315.7110.713.
61. Charkaluk ML, Czernichow P, Lévy-Marchal C. Incidence data of childhood-onset type I diabetes in France during 1988-1997: the case for a shift toward younger age at onset. Pediatr Res. 2002;52(6):859-62. doi: 10.1203/00006450-200212000-00008.
62. Giralt Muiña P, Santillana Ferrer L, Madrigal Barchino D, Merlo Garrido A, Toledo De La Torre B, Anaya Barea F. Incidence of diabetes mellitus and prevalence of type 1A diabetes mellitus in children younger than 16 years old from the province of Ciudad Real. An Esp Pediatr. 2001;55(3):213-8.
63. Goday A, Castell C, Tresserras R, Canela J, Taberner JL, Lloveras G. Incidence of type 1 (insulin-dependent) diabetes mellitus in Catalonia, Spain. The Catalan Epidemiology Diabetes Study Group. Diabetologia. 1992;35(3):267-71. doi: 10.1007/bf00400928.
64. Gong C, Meng X, Saenger P, Wu D, Cao B, Wu D, et al. Trends in the incidence of childhood type 1 diabetes mellitus in Beijing based on hospitalization data from 1995 to 2010. Horm Res Paediatr. 2013;80(5):328-34. doi: 10.1159/000355388.
65. Gopinath S, Örtqvist E, Norgren S, Green A, Sanjeevi CB. Variations in incidence of type 1 diabetes in different municipalities of Stockholm. Ann N Y Acad Sci.

2008;1150:200-7. doi: 10.1196/annals.1447.057.
66. Gorham ED, Garland FC, Barrett-Connor E, Garland CF, Wingard DL, Pugh WM. Incidence of insulin-dependent diabetes mellitus in young adults: experience of 1,587,630 US Navy enlisted personnel. Am J Epidemiol. 1993;138(11):984-7. doi: 10.1093/oxfordjournals.aje.a116818.
67. Grabauskas V, Urbonaite B, Padaiga Z. Incidence of childhood insulin-dependent diabetes mellitus in Lithuania 1983-1988. Acta Paediatr Scand. 1991;80(6-7):718-9. doi: 10.1111/j.1651-2227.1991.tb11934.x.
68. Green A, Patterson CC. Trends in the incidence of childhood-onset diabetes in Europe 1989-1998. Diabetologia. 2001;44 Suppl 3:B3-8. doi: 10.1007/pl00002950.
69. Harjutsalo V, Sjöberg L, Tuomilehto J. Time trends in the incidence of type 1 diabetes in Finnish children: a cohort study. Lancet. 2008;371(9626):1777-82. doi: 10.1016/s0140-6736(08)60765-5.
70. Harjutsalo V, Sund R, Knip M, Groop PH. Incidence of type 1 diabetes in Finland. JAMA. 2013;310(4):427-8. doi: 10.1001/jama.2013.8399.
71. Huen KF, Low LC, Wong GW, Tse WW, Yu AC, Lam YY, et al. Epidemiology of diabetes mellitus in children in Hong Kong: the Hong Kong childhood diabetes register. J Pediatr Endocrinol Metab. 2000;13(3):297-302. doi: 10.1515/jpem.2000.13.3.297.
72. Jarosz-Chobot P, Deja G, Polanska J. Epidemiology of type 1 diabetes among Silesian children aged 0-14 years, 1989-2005. Acta Diabetol. 2010;47(1):29-33. doi: 10.1007/s00592-009-0094-7.
73. Jarosz-Chobot P, Polanska J, Szadkowska A, Kretowski A, Bandurska-Stankiewicz E, Ciechanowska M, et al. Rapid increase in the incidence of type 1 diabetes in Polish children from 1989 to 2004, and predictions for 2010 to 2025. Diabetologia. 2011;54(3):508-15. doi: 10.1007/s00125-010-1993-4.
74. Ji J, Hemminki K, Sundquist J, Sundquist K. Ethnic differences in incidence of type 1 diabetes among second-generation immigrants and adoptees from abroad. J Clin Endocrinol Metab. 2010;95(2):847-50. doi: 10.1210/jc.2009-1818.
75. Kadiki OA, Moawad SE. Ten-year incidence (1981-90) of insulin-dependent diabetes in the 0-29-year-old age group in Benghazi, Libya. Diabetes Res Clin Pract. 1994;26(3):223-8. doi: 10.1016/0168-8227(94)90064-7.
76. Kadiki OA, Reddy MR, Marzouk AA. Incidence of insulin-dependent diabetes (IDDM) and non-insulin-dependent diabetes (NIDDM) (0-34 years at onset) in Benghazi, Libya. Diabetes Res Clin Pract. 1996;32(3):165-73. doi: 10.1016/0168-8227(96)01262-4.
77. Karvonen M, Tuomilehto J, Virtala E, Pitkäniemi J, Reunanen A, Tuomilehto-Wolf E, et al. Seasonality in the clinical onset of insulin-dependent diabetes mellitus in Finnish children. Childhood Diabetes in Finland (DiMe) Study Group. Am J Epidemiol. 1996;143(2):167-76. doi: 10.1093/oxfordjournals.aje.a008726.
78. Karvonen M, Viik-Kajander M, Moltchanova E, Libman I, LaPorte R, Tuomilehto J. Incidence of childhood type 1 diabetes worldwide. Diabetes Mondiale (DiaMond) Project Group. Diabetes Care. 2000;23(10):1516-26. doi: 10.2337/diacare.23.10.1516.
79. Karvonen M, Rusanen J, Sundberg M, Virtala E, Colpaert A, Naukkarinen A, et al. Regional differences in the incidence of insulin-dependent diabetes mellitus among children in Finland from 1987 to 1991. Childhood Diabetes in Finland (DiMe) Study Group. Ann Med. 1997;29(4):297-304. doi: 10.3109/07853899708999351.
80. Kida K, Kaino Y, Ito T, Hirai H, Nakamura K. Immunogenetics of insulin-dependent diabetes mellitus. Acta Paediatr. 1999;88(s427):3-7. doi: 10.1111/j.1651-2227.1999.tb14332.x.
81. Koton S. Incidence of type 1 diabetes mellitus in the 0- to 17-yr-old Israel population, 1997-2003. Pediatr Diabetes. 2007;8(2):60-6. doi: 10.1111/j.1399-5448.2007.00230.x.
82. Kulaylat NA, Narchi H. A twelve year study of the incidence of childhood type 1 diabetes mellitus in the Eastern Province of Saudi Arabia. J Pediatr Endocrinol Metab. 2000;13(2):135-40. doi: 10.1515/jpem.2000.13.2.135.
83. Lammi N, Taskinen O, Moltchanova E, Notkola IL, Eriksson JG, Tuomilehto J, et al. A high incidence of type 1 diabetes and an alarming increase in the incidence of type 2 diabetes among young adults in Finland between 1992 and 1996. Diabetologia. 2007;50(7):1393-400. doi: 10.1007/s00125-007-0690-4.
84. Larenas G, Montecinos A, Manosalva M, Barthou M, Vidal T. Incidence of insulin-dependent diabetes mellitus in the IX region of Chile: ethnic differences. Diabetes Res Clin Pract. 1996;34 Suppl:S147-51. doi: 10.1016/s0168-8227(96)90022-4.
85. Lawrence JM, Imperatore G, Dabelea D, Mayer-Davis EJ, Linder B, Saydah S, et al. Trends in incidence of type 1 diabetes among non-Hispanic white youth in the U.S., 2002-2009. Diabetes. 2014;63(11):3938-45. doi: 10.2337/db13-1891.
86. Legault L, Polychronakos C. Annual incidence of type 1 diabetes in Quebec between 1989-2000 in children. Clin Invest Med. 2006;29(1):10-3.
87. Libman IM, LaPorte RE, Becker D, Dorman JS, Drash AL, Kuller L. Was there an epidemic of diabetes in nonwhite adolescents in Allegheny County, Pennsylvania? Diabetes Care. 1998;21(8):1278-81. doi: 10.2337/diacare.21.8.1278.
88. Lin WH, Wang MC, Wang WM, Yang DC, Lam CF, Roan JN, et al. Incidence of and mortality from type I diabetes in Taiwan from 1999 through 2010: a nationwide cohort study. PLoS One. 2014;9(1):e86172. doi: 10.1371/journal.pone.0086172.
89. Lipman TH. The epidemiology of type I diabetes in children 0-14 yr of age in Philadelphia. Diabetes Care. 1993;16(6):922-5. doi: 10.2337/diacare.16.6.922.
90. Lipman TH, Chang Y, Murphy KM. The epidemiology of type 1 diabetes in children in Philadelphia 1990-1994: evidence of an epidemic. Diabetes Care. 2002;25(11):1969-75. doi: 10.2337/diacare.25.11.1969.
91. Lipman TH, Jawad AF, Murphy KM, Tuttle A, Thompson RL, Ratcliffe SJ, et al. Incidence of type 1 diabetes in Philadelphia is higher in black than white children from 1995 to 1999: epidemic or misclassification? Diabetes Care. 2006;29(11):2391-5. doi: 10.2337/dc06-0517.
92. Lipman TH, Levitt Katz LE, Ratcliffe SJ, Murphy KM, Aguilar A, Rezvani I, et al. Increasing incidence of type 1 diabetes in youth: twenty years of the Philadelphia Pediatric Diabetes Registry. Diabetes Care. 2013;36(6):1597-603. doi: 10.2337/dc12-0767.
93. Lipton R, Keenan H, Onyemere KU, Freels S. Incidence and onset features of diabetes in African-American and Latino children in Chicago, 1985-1994. Diabetes Metab Res Rev. 2002;18(2):135-42. doi: 10.1002/dmrr.265.
94. Lisbôa HR, Graebin R, Butzke L, Rodrigues CS. Incidence

of type 1 diabetes mellitus in Passo Fundo, RS, Brazil. Braz J Med Biol Res. 1998;31(12):1553-6. doi: 10.1590/s0100-879x1998001200007.
95. Li XH, Li TL, Yang Z, Liu ZY, Wei YD, Jin SX, et al. A nine-year prospective study on the incidence of childhood type 1 diabetes mellitus in China. Biomed Environ Sci. 2000;13(4):263-70.
96. Lora-Gómez RE, Morales-Pérez FM, Arroyo-Díez FJ, Barquero-Romero J. Incidence of Type 1 diabetes in children in Cáceres, Spain, during 1988-1999. Diabetes Res Clin Pract. 2005;69(2):169-74. doi: 10.1016/j.diabres.2004.11.013.
97. Mamoulakis D, Galanakis E, Bicouvarakis S, Paraskakis E, Sbyrakis S. Epidemiology of childhood type I diabetes in Crete, 1990-2001. Acta Paediatr. 2003;92(6):737-9. doi: 10.1080/08035250310002588.
98. Martinucci ME, Curradi G, Fasulo A, Medici A, Toni S, Osovik G, et al. Incidence of childhood type 1 diabetes mellitus in Gomel, Belarus. J Pediatr Endocrinol Metab. 2002;15(1):53-7. doi: 10.1515/jpem.2002.15.1.53.
99. Mauny F, Grandmottet M, Lestradet C, Guitard J, Crenn D, Floret N, et al. Increasing trend of childhood type 1 diabetes in Franche-Comté (France): analysis of age and period effects from 1980 to 1998. Eur J Epidemiol. 2005;20(4):325-9. doi: 10.1007/s10654-005-0329-z.
100. Mayer-Davis EJ, Beyer J, Bell RA, Dabelea D, D'Agostino R Jr, Imperatore G, et al. Diabetes in African American youth: prevalence, incidence, and clinical characteristics: the SEARCH for Diabetes in Youth Study. Diabetes Care. 2009;32 Suppl 2:S112-22. doi: 10.2337/dc09-S203.
101. Mazzella M, Cotellessa M, Bonassi S, Mulas R, Caratozzolo A, Gaber S, et al. Incidence of type I diabetes in the Liguria Region, Italy. Results of a prospective study in a 0- to 14-year age-group. Diabetes Care. 1994;17(10):1193-6. doi: 10.2337/diacare.17.10.1193.
102. Metcalfe MA, Baum JD. Incidence of insulin dependent diabetes in children aged under 15 years in the British Isles during 1988. BMJ. 1991;302(6774):443-7. doi: 10.1136/bmj.302.6774.443.
103. Michalková D, Minárik P, Hlava P, Camajová J, Nazarov V. Trends in the incidence of childhood-onset type 1 diabetes in Slovakia 1985 - 2000. Cent Eur J Public Health. 2004;12(2):75-7.
104. Morales-Pérez FM, Barquero-Romero J, Pérez-Miranda M. Incidence of type I diabetes among children and young adults (0-29 years) in the province of Badajoz, Spain during 1992 to 1996. Acta Paediatr. 2000;89(1):101-4. doi: 10.1080/080352500750029158.
105. Muiña PG, Herrera MJ, Atance EP, Donado JJ, Sánchez G, Ferrer LS. Epidemiological study of type 1 diabetes in children under 15 years-old in Castilla-La Mancha (Spain). An Pediatr (Barc). 2012;76(2):83-91. doi: 10.1016/j.anpedi.2011.02.007.
106. Muntoni S, Songini M. High incidence rate of IDDM in Sardinia. Sardinian Collaborative Group for Epidemiology of IDDM. Diabetes Care. 1992;15(10):1317-22. doi: 10.2337/diacare.15.10.1317.
107. Muntoni S, Fonte MT, Stoduto S, Marietti G, Bizzarri C, Crinò A, et al. Incidence of insulin-dependent diabetes mellitus among Sardinian-heritage children born in Lazio region, Italy. Lancet. 1997;349(9046):160-2. doi: 10.1016/s0140-6736(96)04241-9.
108. Neu A, Kehrer M, Hub R, Ranke MB. Incidence of IDDM in German children aged 0-14 years. A 6-year population-based study (1987-1993). Diabetes Care. 1997;20(4):530-3. doi: 10.2337/diacare.20.4.530.
109. Neu A, Willasch A, Ehehalt S, Kehrer M, Hub R, Ranke MB. Diabetes incidence in children of different nationalities: an epidemiological approach to the pathogenesis of diabetes. Diabetologia. 2001;44 Suppl 3:B21-6. doi: 10.1007/pl00002948.
110. Newhook LA, Curtis J, Hagerty D, Grant M, Paterson AD, Crummel C, et al. High incidence of childhood type 1 diabetes in the Avalon Peninsula, Newfoundland, Canada. Diabetes Care. 2004;27(4):885-8. doi: 10.2337/diacare.27.4.885.
111. Newhook LA, Grant M, Sloka S, Hoque M, Paterson AD, Hagerty D, et al. Very high and increasing incidence of type 1 diabetes mellitus in Newfoundland and Labrador, Canada. Pediatr Diabetes. 2008;9(3 Pt 2):62-8. doi: 10.1111/j.1399-5448.2007.00315.x.
112. Newhook LA, Penney S, Fiander J, Dowden J. Recent incidence of type 1 diabetes mellitus in children 0-14 years in Newfoundland and Labrador, Canada climbs to over 45/100 000: a retrospective time trend study. BMC Res Notes. 2012;5:628. doi: 10.1186/1756-0500-5-628.
113. Ostrauskas R, Žalinkevičius R, Jurgevičienė N, Radzevičienė L, Lašaitė L. The incidence of type 1 diabetes mellitus among 15-34 years aged Lithuanian population: 18-year incidence study based on prospective databases. BMC Public Health. 2011;11:813. doi: 10.1186/1471-2458-11-813.
114. Patterson CC, Dahlquist G, Soltesz G, Green A. Variation and trends in incidence of childhood diabetes in Europe. Lancet. 2000;355(9207):873-6.
115. Patterson CC, Dahlquist G, Soltész G, Green A. Is childhood-onset type I diabetes a wealth-related disease? An ecological analysis of European incidence rates. Diabetologia. 2001;44 Suppl 3:B9-16. doi: 10.1007/pl00002961.
116. Peter SA, Johnson R, Taylor C, Hanna A, Roberts P, McNeil P, et al. The incidence and prevalence of type-1 diabetes mellitus. J Natl Med Assoc. 2005;97(2):250-2.
117. Pinelli L, Beretta F, Dalla Bernardina P, Gonfiantini E, Groff P. Incidence of insulin dependent diabetes mellitus in children 0-14 years old in the Veneto Region, Italy. J Pediatr Endocrinol Metab. 1998;11(3):447-50. doi: 10.1515/jpem.1998.11.3.447.
118. Pishdad GR. Low incidence of type 1 diabetes in Iran. Diabetes Care. 2005;28(4):927-8. doi: 10.2337/diacare.28.4.927.
119. Podar T, Tuomilehto-Wolf E, Tuomilehto J, LaPorte RE, Adojaan B. Insulin-dependent diabetes mellitus in native Estonians and immigrants to Estonia. Am J Epidemiol. 1992;135(11):1231-6. doi: 10.1093/oxfordjournals.aje.a116229.
120. Polanska J, Deja G, Chobot A, Jarosz-Chobot P. The increase of incidence rate of diabetes mellitus type 1(T1DM) among Silesian children (Poland) still maintains the high tempo, in years 1989-2012. Pediatr Diabetes. 2014;15:49-137. doi:10.1111/pedi.12194_2
121. Prisco F, Vicedomini D, Iafusco D, De Felice E, Amodeo BM, Palumbo F. Incidence of IDDM in the Campania region, Italy. Diabetes Care. 1996;19(12):1454-5. doi: 10.2337/diacare.19.12.1454.
122. Pronina EA, Petraikina EE, Antsiferov MB, Duchareva OV, Petrone A, Buzzetti R, et al. A 10-year (1996-2005) prospective study of the incidence of type 1 diabetes in Moscow in the age group 0-14 years. Diabet Med. 2008;25(8):956-9. doi: 10.1111/j.1464-5491.2008.02508.x.
123. Pundziute-Lycká A, Urbonaite B, Ostrauskas R, Zalinkevicius R, Dahlquist GG. Incidence of type 1 diabetes in Lithuanians

aged 0-39 years varies by the urban-rural setting, and the time change differs for men and women during 1991-2000. Diabetes Care. 2003;26(3):671-6. doi: 10.2337/diacare.26.3.671.
124. Radosevic B, Bukara-Radujkovic G, Miljkovic V, Pejicic S, Bratina N, Battelino T. The incidence of type 1 diabetes in Republic of Srpska (Bosnia and Herzegovina) and Slovenia in the period 1998-2010. Pediatr Diabetes. 2013;14(4):273-9. doi: 10.1111/j.1399-5448.2012.00898.x.
125. Ramachandran A, Snehalatha C, Krishnaswamy CV. Incidence of IDDM in children in urban population in southern India. Madras IDDM Registry Group Madras, South India. Diabetes Res Clin Pract. 1996;34(2):79-82. doi: 10.1016/s0168-8227(96)01338-1.
126. Rami B, Waldhör T, Schober E. Incidence of type I diabetes mellitus in children and young adults in the province of Upper Austria, 1994-1996. Diabetologia. 2001;44 Suppl 3:B45-7. doi: 10.1007/pl00002953.
127. Rangasami JJ, Greenwood DC, McSporran B, Smail PJ, Patterson CC, Waugh NR. Rising incidence of type 1 diabetes in Scottish children, 1984-93. The Scottish Study Group for the Care of Young Diabetics. Arch Dis Child. 1997;77(3):210-3. doi: 10.1136/adc.77.3.210.
128. Serrano Ríos M, Moy CS, Martín Serrano R, Minuesa Asensio A, de Tomás Labat ME, Zarandieta Romero G, et al. Incidence of type 1 (insulin-dependent) diabetes mellitus in subjects 0-14 years of age in the Comunidad of Madrid, Spain. Diabetologia. 1990;33(7):422-4. doi: 10.1007/bf00404093.
129. Roche E, Menon A, Gill D, Hoey HM. National incidence of type 1 diabetes in childhood and adolescence. Ir Med J. 2002;95(4):115-6, 8.
130. Rosenbauer J, Herzig P, von Kries R, Neu A, Giani G. Temporal, seasonal, and geographical incidence patterns of type I diabetes mellitus in children under 5 years of age in Germany. Diabetologia. 1999;42(9):1055-9. doi: 10.1007/s001250051270.
131. Aude Rueda O, Libman IM, Altamirano Bustamante N, Robles Valdes C, LaPorte RE. Low incidence of IDDM in children of Veracruz-Boca del Rio, Veracruz. Results of the first validated IDDM registry in Mexico. Diabetes Care. 1998;21(8):1372-3. doi: 10.2337/diacare.21.8.1372.
132. Rytkönen M, Moltchanova E, Ranta J, Taskinen O, Tuomilehto J, Karvonen M. The incidence of type 1 diabetes among children in Finland--rural-urban difference. Health Place. 2003;9(4):315-25. doi: 10.1016/s1353-8292(02)00064-3.
133. Samardzic M, Marinkovic J, Kocev N, Curovic N, Terzic N. Increasing incidence of childhood type 1 diabetes in Montenegro from 1997 to 2006. Pediatr Diabetes. 2010;11(6):412-6. doi: 10.1111/j.1399-5448.2009.00617.x.
134. Samuelsson U, Johansson C, Carstensen J, Ludvigsson J. Space-time clustering in insulin-dependent diabetes mellitus (IDDM) in south-east Sweden. Int J Epidemiol. 1994;23(1):138-42. doi: 10.1093/ije/23.1.138.
135. Santos J, Carrasco E, Moore A, Pérez-Bravo F, Albala C. Incidence rate and spatio-temporal clustering of type 1 diabetes in Santiago, Chile, from 1997 to 1998. Rev Saude Publica. 2001;35(1):96-100. doi: 10.1590/s0034-89102001000100014.
136. Sasaki A, Okamoto N. Epidemiology of childhood diabetes in Osaka District, Japan, using the documents from the medical benefits system specific for childhood diabetes. Diabetes Res Clin Pract. 1992;18(3):191-6. doi: 10.1016/0168-8227(92)90145-h.
137. Schober E, Schneider U, Waldhör T, Tuomilehto J. Increasing incidence of IDDM in Austrian children. A nationwide study 1979-1993. Austrian Diabetes Incidence Study Group. Diabetes Care. 1995;18(9):1280-3. doi: 10.2337/diacare.18.9.1280.
138. Schober E, Waldhoer T, Rami B, Hofer S. Incidence and time trend of type 1 and type 2 diabetes in Austrian children 1999-2007. J Pediatr. 2009;155(2):190-3.e1. doi: 10.1016/j.jpeds.2009.03.010.
139. Schoenle EJ, Lang-Muritano M, Gschwend S, Laimbacher J, Mullis PE, Torresani T, et al. Epidemiology of type I diabetes mellitus in Switzerland: steep rise in incidence in under 5 year old children in the past decade. Diabetologia. 2001;44(3):286-9. doi: 10.1007/s001250051615.
140. Scott RS, Brown LJ, Darlow BA, Forbes LV, Moore MP. Temporal variation in incidence of IDDM in Canterbury, New Zealand. Diabetes Care. 1992;15(7):895-9. doi: 10.2337/diacare.15.7.895.
141. Sebastiani L, Visalli N, Adorisio E, Suppa MA, Buzzetti R, De Cicco AL, et al. A 5-year (1989-1993) prospective study of the incidence of IDDM in Rome and the Lazio region in the age-group 0-14 years. Diabetes Care. 1996;19(1):70-3. doi: 10.2337/diacare.19.1.70.
142. Sella T, Shoshan A, Goren I, Shalev V, Blumenfeld O, Laron Z, et al. A retrospective study of the incidence of diagnosed Type 1 diabetes among children and adolescents in a large health organization in Israel, 2000-2008. Diabet Med. 2011;28(1):48-53. doi: 10.1111/j.1464-5491.2010.03174.x.
143. Sereday MS, Martí ML, Damiano MM, Moser ME. Establishment of a registry and incidence of IDDM in Avellaneda, Argentina. Diabetes Care. 1994;17(9):1022-5. doi: 10.2337/diacare.17.9.1022.
144. Shaltout AA, Moussa MA, Qabazard M, Abdella N, Karvonen M, Al-Khawari M, et al. Further evidence for the rising incidence of childhood Type 1 diabetes in Kuwait. Diabet Med. 2002;19(6):522-5. doi: 10.1046/j.1464-5491.2002.00703.x.
145. Shamis I, Gordon O, Albag Y, Goldsand G, Laron Z. Ethnic differences in the incidence of childhood IDDM in Israel (1965-1993). Marked increase since 1985, especially in Yemenite Jews. Diabetes Care. 1997;20(4):504-8. doi: 10.2337/diacare.20.4.504.
146. López Siguero JP, Martínez Aedo Ollero MJ, Molina JA, Lora Espinosa A, Valverde AM. Evolución de la incidencia de la diabetes mellitus tipo I en niños de 0 a 14 años en Málaga (1982-1993). An Esp Pediatr. 1997;47(1):17-22. [Spanish].
147. Sipetic S, Maksimovic J, Vlajinac H, Ratkov I, Sajic S, Zdravkovic D, et al. Rising incidence of type 1 diabetes in Belgrade children aged 0-14 years in the period from 1982 to 2005. J Endocrinol Invest. 2013;36(5):307-12. doi: 10.3275/8619.
148. Skordis N, Hadjiloizou S. Incidence of insulin dependent diabetes mellitus in Greek Cypriot children and adolescents, 1990-1994. J Pediatr Endocrinol Metab. 1997;10(2):203-7. doi: 10.1515/jpem.1997.10.2.203.
149. Skordis N, Theodorou S, Apsiotou T, Stavrou S, Herakleous E, Savva SC. The incidence of type 1 diabetes mellitus in Greek-Cypriot children and adolescents in 1990-2000. Pediatr Diabetes. 2002;3(4):200-4. doi: 10.1034/j.1399-5448.2002.30406.x.
150. Skordis N, Efstathiou E, Kyriakides TC, Savvidou A, Savva SC, Phylactou LA, et al. Epidemiology of type 1 diabetes mellitus in Cyprus: rising incidence at the dawn of the 21st

century. Hormones (Athens). 2012;11(1):86-93. doi: 10.1007/bf03401541.
151. Skrivarhaug T, Stene LC, Drivvoll AK, Strom H, Joner G. Incidence of type 1 diabetes in Norway among children aged 0-14 years between 1989 and 2012: has the incidence stopped rising? results from the Norwegian Childhood Diabetes Registry. Diabetologia. 2014;57(1):57-62. doi: 10.1007/s00125-013-3090-y.
152. Smith TL, Drum ML, Lipton RB. Incidence of childhood type I and non-type 1 diabetes mellitus in a diverse population: the Chicago Childhood Diabetes Registry, 1994 to 2003. J Pediatr Endocrinol Metab. 2007;20(10):1093-107. doi: 10.1515/jpem.2007.20.10.1093.
153. Staines A, Bodansky HJ, Lilley HE, Stephenson C, McNally RJ, Cartwright RA. The epidemiology of diabetes mellitus in the United Kingdom: the Yorkshire regional childhood diabetes register. Diabetologia. 1993;36(12):1282-7. doi: 10.1007/bf00400806.
154. Staines A, Bodansky HJ, McKinney PA, Alexander FE, McNally RJ, Law GR, et al. Small area variation in the incidence of childhood insulin-dependent diabetes mellitus in Yorkshire, UK: links with overcrowding and population density. Int J Epidemiol. 1997;26(6):1307-13. doi: 10.1093/ije/26.6.1307.
155. Stipancic G, La Grasta Sabolic L, Malenica M, Radica A, Skrabic V, Tiljak MK. Incidence and trends of childhood type 1 diabetes in Croatia from 1995 to 2003. Diabetes Res Clin Pract. 2008;80(1):122-7. doi: 10.1016/j.diabres.2007.10.019.
156. Svensson J, Carstensen B, Molbak A, Christau B, Mortensen HB, Nerup J, et al. Increased risk of childhood type 1 diabetes in children born after 1985. Diabetes Care. 2002;25(12):2197-201. doi: 10.2337/diacare.25.12.2197.
157. Svensson J, Ramelius A, Eising S, Mortensen H, Lernmark Å, Pociot F, et al. Decreasing humoral activity in siblings of type 1 diabetes children over a ten year period with increasing incidence of the disease. Diabetologia. 2008;51(S1):232-3.
158. Swai AB, Lutale JL, McLarty DG. Prospective study of incidence of juvenile diabetes mellitus over 10 years in Dar es Salaam, Tanzania. BMJ. 1993;306(6892):1570-2. doi: 10.1136/bmj.306.6892.1570.
159. Tahirovic H, Toromanovic A, Bacaj D, Hasanovic E. Ketoacidosis at onset of type 1 diabetes mellitus in children in Bosnia and Herzegovina: frequency and clinical presentation. J Pediatr Endocrinol Metab. 2007;20(10):1137-40. doi: 10.1515/jpem.2007.20.10.1137.
160. Taplin CE, Craig ME, Lloyd M, Taylor C, Crock P, Silink M, et al. The rising incidence of childhood type 1 diabetes in New South Wales, 1990-2002. Med J Aust. 2005;183(5):243-6.
161. Teeäär T, Liivak N, Heilman K, Kool P, Sor R, Paal M, et al. Increasing incidence of childhood-onset type 1 diabetes mellitus among Estonian children in 1999-2006. Time trend analysis 1983-2006. Pediatr Diabetes. 2010;11(2):107-10. doi: 10.1111/j.1399-5448.2009.00535.x.
162. Thunander M, Petersson C, Jonzon K, Fornander J, Ossiansson B, Torn C, et al. Incidence of type 1 and type 2 diabetes in adults and children in Kronoberg, Sweden. Diabetes Res Clin Pract. 2008;82(2):247-55. doi: 10.1016/j.diabres.2008.07.022.
163. Torffvit O, Eriksson JW, Henricsson M, Sundkvist G, Arnqvist HJ, Blohmé G, et al. Early changes in glomerular size selectivity in young adults with type 1 diabetes and retinopathy. Results from the Diabetes Incidence Study in Sweden. J Diabetes Complications. 2007;21(4):246-51. doi: 10.1016/j.jdiacomp.2006.01.002.
164. Toth EL, Lee KC, Couch RM, Martin LF. High incidence of IDDM over 6 years in Edmonton, Alberta, Canada. Diabetes Care. 1997;20(3):311-3. doi: 10.2337/diacare.20.3.311.
165. Toumba M, Savva SC, Bacopoulou I, Apsiotou T, Georgiou T, Stavrou S, et al. Rising incidence of type 1 diabetes mellitus in children and adolescents in Cyprus in 2000-2004. Pediatr Diabetes. 2007;8(6):374-6. doi: 10.1111/j.1399-5448.2007.00262.x.
166. Tran F, Stone M, Huang CY, Lloyd M, Woodhead HJ, Elliott KD, et al. Population-based incidence of diabetes in Australian youth aged 10-18 yr: increase in type 1 diabetes but not type 2 diabetes. Pediatr Diabetes. 2014;15(8):585-90. doi: 10.1111/pedi.12131.
167. Tuchinda C, Likitmaskul S, Unachak K, Panamonta O, Patarakijavanich N, Chetthakul T. The epidemiology of type 1 diabetes in Thai children. J Med Assoc Thai. 2002;85(6):648-52.
168. Tull ES, Roseman JM, Christian CL. Epidemiology of childhood IDDM in U.S. Virgin Islands from 1979 to 1988. Evidence of an epidemic in early 1980s and variation by degree of racial admixture. Diabetes Care. 1991;14(7):558-64. doi: 10.2337/diacare.14.7.558.
169. Tuomilehto J, Podar T, Reunanen A, Kalits I, Lounamaa R, Tuomilehto-Wolf E, et al. Comparison of incidence of IDDM in childhood between Estonia and Finland, 1980-1988. Diabetes Care. 1991;14(11):982-8. doi: 10.2337/diacare.14.11.982.
170. Tuomilehto-Wolf E, Podar T, Adojaan B, Kalits I, Tuomilehto J. Can the difference in incidence of type 1 diabetes between Estonia and Finland be partly explained by genetic reasons. Diabetologia. 1991;34(Suppl 2):A65.
171. Tuomilehto J, Lounamaa R, Tuomilehto-Wolf E, Reunanen A, Virtala E, Kaprio EA, et al. Epidemiology of childhood diabetes mellitus in Finland--background of a nationwide study of type 1 (insulin-dependent) diabetes mellitus. The Childhood Diabetes in Finland (DiMe) Study Group. Diabetologia. 1992;35(1):70-6. doi: 10.1007/bf00400854.
172. Tuomilehto J, Podar T, Brigis G, Urbonaite B, Rewers M, Adojaan B, et al. Comparison of the incidence of insulin-dependent diabetes mellitus in childhood among five Baltic populations during 1983-1988. Int J Epidemiol. 1992;21(3):518-27. doi: 10.1093/ije/21.3.518.
173. Tuomilehto J, Dabee J, Karvonen M, Dowse GK, Gareeboo H, Virtala E, et al. Incidence of IDDM in Mauritian children and adolescents from 1986 to 1990. Diabetes Care. 1993;16(12):1588-91. doi: 10.2337/diacare.16.12.1588.
174. Tuomilehto J, Karvonen M, Pitkaniemi J, Virtala E, Kohtamaki K, Toivanen L, et al. Record-high incidence of type I (insulin-dependent) diabetes mellitus in Finnish children. The Finnish Childhood Type I Diabetes Registry Group. Diabetologia. 1999;42(6):655-60. doi: 10.1007/s001250051212.
175. Tzaneva V, Iotova V, Bruining GJ. Increase in IDDM incidence in Bulgarian children (1974-1995). J Pediatr Endocrinol Metab. 1998;11(6):725-32. doi: 10.1515/jpem.1998.11.6.725.
176. Vandewalle CL, Coeckelberghs MI, De Leeuw IH, Du Caju MV, Schuit FC, Pipeleers DG, et al. Epidemiology, clinical aspects, and biology of IDDM patients under age 40 years. Comparison of data from Antwerp with complete ascertainment with data from Belgium with 40% ascertainment. The Belgian Diabetes Registry. Diabetes Care. 1997;20(10):1556-61. doi: 10.2337/diacare.20.10.1556.
177. Vehik K, Hamman RF, Lezotte D, Norris JM, Klingensmith G, Bloch C, et al. Increasing incidence of type 1 diabetes in 0-to

17-year-old Colorado youth. Diabetes Care. 2007;30(3):503-9.
178. Verge CF, Silink M, Howard NJ. The incidence of childhood IDDM in New South Wales, Australia. Diabetes Care. 1994;17(7):693-6. doi: 10.2337/diacare.17.7.693.
179. Vichi M, Iafusco D, Galderisi A, Stazi MA, Nisticò L. An easy, fast, effective tool to monitor the incidence of type 1 diabetes among children aged 0-4 years in Italy: the Italian Hospital Discharge Registry (IHDR). Acta Diabetol. 2014;51(2):287-94. doi: 10.1007/s00592-014-0556-4.
180. Vlajinac HD, Bojović BM, Sipetić SB, Adanja BJ, Jarebinski MS, Radmanović SZ, et al. Insulin dependent diabetes mellitus: incidence in childhood in Belgrade 1982-92. J Epidemiol Community Health. 1995;49(1):107-8. doi: 10.1136/jech.49.1.107.
181. Vos C, Reeser HM, Hirasing RA, Bruining GJ. Confirmation of high incidence of type 1 (insulin-dependent) diabetes mellitus in Moroccan children in The Netherlands. Diabet Med. 1997;14(5):397-400. doi: 10.1002/(sici)1096-9136(199705)14:5<397::aid-dia358>3.0.co;2-j.
182. Wadsworth E, Shield J, Hunt L, Baum D. Insulin dependent diabetes in children under 5: incidence and ascertainment validation for 1992. BMJ. 1995;310(6981):700-3. doi: 10.1136/bmj.310.6981.700.
183. Washington RE, Orchard TJ, Arena VC, LaPorte RE, Tull ES. Incidence of type 1 and type 2 diabetes in youth in the US Virgin Islands, 2001–2010. Pediatr Diabetes. 2012;14(4):280-7.
184. Willis JA, Scott RS, Darlow BA, Nesbit JW, Anderson P, Moore MP, et al. Incidence of type 1 diabetes mellitus diagnosed before age 20 years in Canterbury, New Zealand over the last 30 years. J Pediatr Endocrinol Metab. 2002;15(5):637-43. doi: 10.1515/jpem.2002.15.5.637.
185. Wong GW. Insulin-dependent diabetes mellitus in southern Chinese children: an overview. J Paediatr Child Health. 1994;30(6):490-1. doi: 10.1111/j.1440-1754.1994.tb00718.x.
186. Wong GW, Leung SS, Oppenheimer SJ. Epidemiology of IDDM in southern Chinese children in Hong Kong. Diabetes Care. 1993;16(6):926-8. doi: 10.2337/diacare.16.6.926.
187. Yang Z, Wang K, Li T, Sun W, Li Y, Chang YF, et al. Childhood diabetes in China. Enormous variation by place and ethnic group. Diabetes Care. 1998;21(4):525-9. doi: 10.2337/diacare.21.4.525.
188. Yang Z, Long X, Shen J, Liu D, Dorman JS, Laporte RE, et al. Epidemics of type 1 diabetes in China. Pediatr Diabetes. 2005;6(3):122-8. doi: 10.1111/j.1399-543X.2005.00116.x.
189. Zalutskaya A, Bornstein SR, Mokhort T, Garmaev D. Did the Chernobyl incident cause an increase in type 1 diabetes mellitus incidence in children and adolescents? Diabetologia. 2004;47(1):147-8. doi: 10.1007/s00125-003-1271-9.
190. Zhao HX, Stenhouse E, Soper C, Hughes P, Sanderson E, Baumer JH, et al. Incidence of childhood-onset type 1 diabetes mellitus in Devon and Cornwall, England, 1975-1996. Diabet Med. 1999;16(12):1030-5. doi: 10.1046/j.1464-5491.1999.00175.x.
191. Zhao Z, Sun C, Wang C, Li P, Wang W, Ye J, et al. Rapidly rising incidence of childhood type 1 diabetes in Chinese population: epidemiology in Shanghai during 1997-2011. Acta Diabetol. 2014;51(6):947-53. doi: 10.1007/s00592-014-0590-2.
192. Zubkiewicz-Kucharska A, Noczyńska A. Epidemiology of type 1 diabetes in Lower Silesia in the years 2000-2005. Pediatr Endocrinol Diabetes Metab. 2010;16(1):45-9.
193. Akazawa Y. Prevalence and incidence of diabetes mellitus by WHO criteria. Diabetes Res Clin Pract. 1994;24 Suppl:S23-7. doi: 10.1016/0168-8227(94)90223-2.
194. Akesen E, Turan S, Güran T, Atay Z, Save D, Bereket A. Prevalence of type 1 diabetes mellitus in 6-18-yr-old school children living in Istanbul, Turkey. Pediatr Diabetes. 2011;12(6):567-71. doi: 10.1111/j.1399-5448.2010.00744.x.
195. Al-Herbish AS, El-Mouzan MI, Al-Salloum AA, Al-Qurachi MM, Al-Omar AA. Prevalence of type 1 diabetes mellitus in Saudi Arabian children and adolescents. Saudi Med J. 2008;29(9):1285-8.
196. Dabelea D, Mayer-Davis EJ, Saydah S, Imperatore G, Linder B, Divers J, et al. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. JAMA. 2014;311(17):1778-86. doi: 10.1001/jama.2014.3201.
197. Elamin A, Omer MI, Hofvander Y, Tuvemo T. Prevalence of IDDM in schoolchildren in Khartoum, Sudan. Diabetes Care. 1989;12(6):430-2. doi: 10.2337/diacare.12.6.430.
198. Eriksson J, Forsen B, Haggblom M, Teppo AM, Groop L. Clinical and metabolic characteristics of type 1 and type 2 diabetes: an epidemiological study from the Närpes community in western Finland. Diabet Med. 1992;9(7):654-60. doi: 10.1111/j.1464-5491.1992.tb01862.x.
199. Evans JM, Newton RW, Ruta DA, MacDonald TM, Morris AD. Socio-economic status, obesity and prevalence of type 1 and type 2 diabetes mellitus. Diabet Med. 2000;17(6):478-80.
200. Garancini MP, Calori G, Ruotolo G, Manara E, Izzo A, Ebbli E, et al. Prevalence of NIDDM and impaired glucose tolerance in Italy: an OGTT-based population study. Diabetologia. 1995;38(3):306-13. doi: 10.1007/bf00400635.
201. Gujral JS, McNally PG, Botha JL, Burden AC. Childhood-onset diabetes in the white and South Asian population in Leicestershire, UK. Diabet Med. 1994;11(6):570-2. doi: 10.1111/j.1464-5491.1994.tb02037.x.
202. Jorge Z, Lacerda Nobre E, Macedo A, Jácome De Castro J. Prevalence of type 1 diabetes mellitus in Portugal, 1995-1999: cohort of young men. Acta Med Port. 2003;16(4):251-3.
203. Kemper AR, Dombkowski KJ, Menon RK, Davis MM. Trends in diabetes mellitus among privately insured children, 1998-2002. Ambul Pediatr. 2006;6(3):178-81. doi: 10.1016/j.ambp.2006.01.001.
204. Moussa MA, Alsaeid M, Abdella N, Refai TM, Al-Sheikh N, Gomez JE. Prevalence of type 1 diabetes among 6- to 18-year-old Kuwaiti children. Med Princ Pract. 2005;14(2):87-91. doi: 10.1159/000083917.
205. Ostrauskas R. The prevalence of type 1 diabetes mellitus among adolescents and adults in Lithuania during 1991-2004. Medicina (Kaunas). 2007;43(3):242-50.
206. Ostrauskas R, Žalinkevičius R. The prevalence of type 1 diabetes mellitus over twelve consecutive years among adults in Lithuania. Baltic Endocrinology. 2006;2(1):1-7.
207. Pettitt DJ, Talton J, Dabelea D, Divers J, Imperatore G, Lawrence JM, et al. Prevalence of diabetes in U.S. youth in 2009: the SEARCH for diabetes in youth study. Diabetes Care. 2014;37(2):402-8. doi: 10.2337/dc13-1838.
208. Ramachandran A, Snehalatha C, Abdul Khader OM, Joseph TA, Viswanathan M. Prevalence of childhood diabetes in an urban population in south India. Diabetes Res Clin Pract. 1992;17(3):227-31. doi: 10.1016/0168-8227(92)90098-c.
209. Soliman AT, al-Salmi IS, Asfour MG. Epidemiology of childhood insulin-dependent diabetes mellitus in the Sultanate of Oman.

Diabet Med. 1996;13(6):582-6. doi: 10.1002/(sici)1096-9136(199606)13:6<582::aid-dia114>3.0.co;2-e.
210. Songini M, Loche M, Muntoni S, Stabilini M, Coppola A, Dessi G, et al. Increasing prevalence of juvenile onset type 1 (insulin-dependent) diabetes mellitus in Sardinia: the military service approach. Diabetologia. 1993;36(6):547-52. doi: 10.1007/bf02743272.
211. Wu D, Kendall D, Lunt H, Willis J, Darlow B, Frampton C. Prevalence of type 1 diabetes in New Zealanders aged 0-24 years. N Z Med J. 2005;118(1218):U1557.
212. Mehta S, Yu EA, Ahamed SF, Bonam W, Kenneth J. Rifampin resistance and diabetes mellitus in a cross-sectional study of adult patients in rural South India. BMC Infect Dis. 2015;15:451. doi: 10.1186/s12879-015-1204-5.
213. Lin YH, Chen CP, Chen PY, Huang JC, Ho C, Weng HH, et al. Screening for pulmonary tuberculosis in type 2 diabetes elderly: a cross-sectional study in a community hospital. BMC Public Health. 2015;15:3. doi: 10.1186/1471-2458-15-3.
214. Jawad F, Shera AS, Memon R, Ansari G. Glucose intolerance in pulmonary tuberculosis. J Pak Med Assoc. 1995;45(9):237-8.
215. Kumpatla S, Sekar A, Achanta S, Sharath BN, Kumar AM, Harries AD, et al. Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India. Public Health Action. 2013;3(Suppl 1):S23-8. doi: 10.5588/pha.13.0035.
216. Jali MV, Mahishale VK, Hiremath MB. Bidirectional screening of tuberculosis patients for diabetes mellitus and diabetes patients for tuberculosis. Diabetes Metab J. 2013;37(4):291-5. doi: 10.4093/dmj.2013.37.4.291.