



15 December 1922



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DKA Zero

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Progetto DKA Zero

Individuare e mettere in atto strategie per prevenire la DKA e i danni che essa provoca, attraverso la sensibilizzazione della opinione pubblica e un'azione di rete all'interno del sistema sanitario nazionale.

Diabetic Keto-Acidosis, DKA

Clinical Signs

- Dehydration
- Tachycardia
- Tachypnea
- Deep sighing respiration
- Breath smells of acetone
- Nausea and/or vomiting
- Abdominal pain
- Blurry vision
- Confusion
- Drowsiness
- Progressive decrease in level of consciousness
- Loss of consciousness (coma)

Diabetic Keto-Acidosis, DKA

Biochemical criteria

- Hyperglycemia (blood glucose >11 mmol/L [≈ 200 mg/dL])
- Venous pH <7.3 or serum bicarbonate <15 mmol/L
- Ketonemia (blood β -hydroxybutyrate ≥ 3 mmol/L) or moderate or large ketonuria.

Conseguenze della DKA

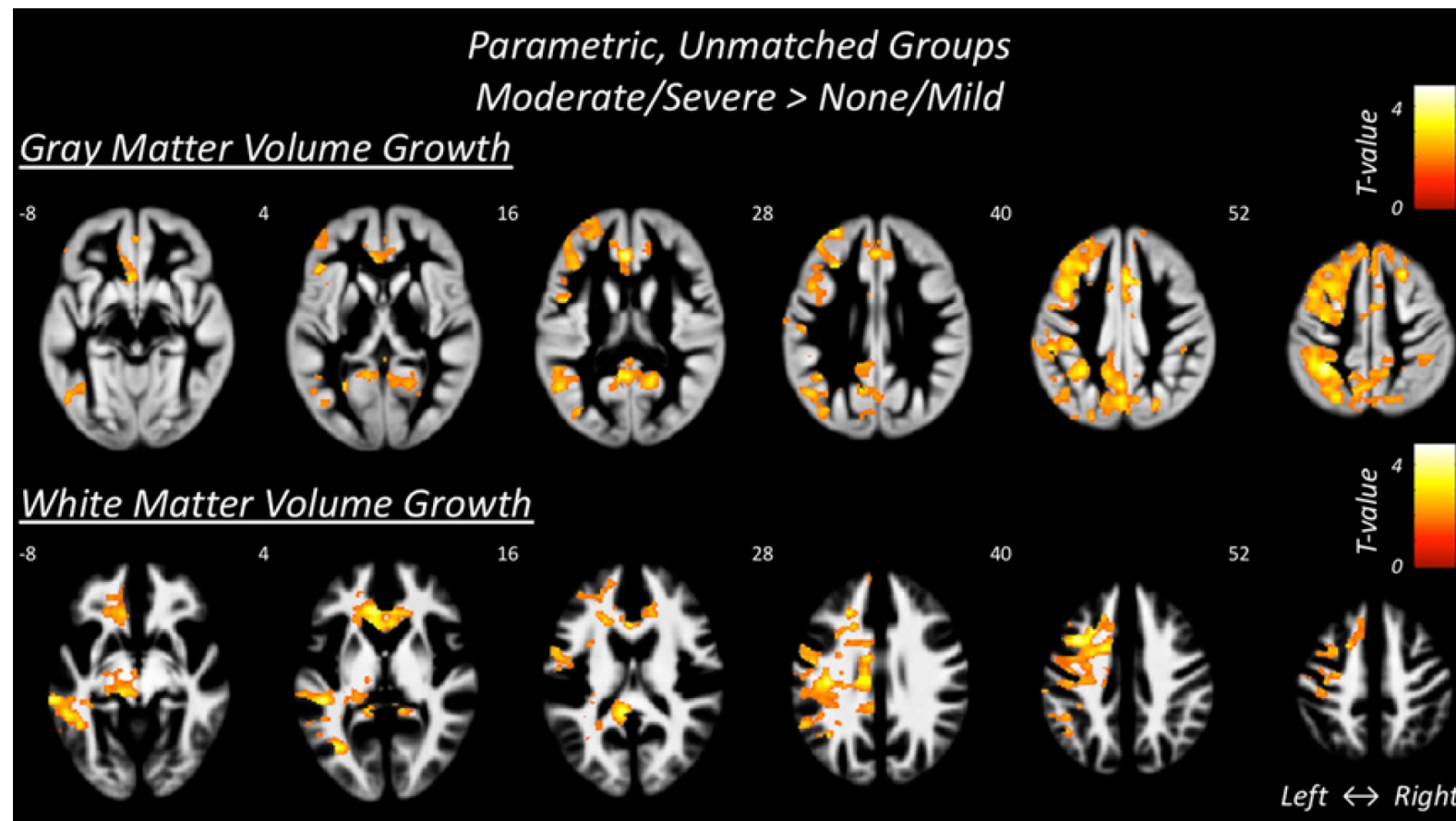
1. Rischio di morte
2. Possibile danno neurologico permanente
3. Riduzione capacità cognitive
4. Controllo metabolico peggiore nel lungo periodo
5. Costi sanitari elevati

A single episode of moderate/severe DKA in young children at diagnosis is associated with lower cognitive scores and altered brain growth

Data from 144 children with type 1 diabetes, ages 4 to <10 years

Each participant had MRI scans and cognitive testing at baseline and 18 months.

Color map represents the statistical significance of **growth differences** between groups.

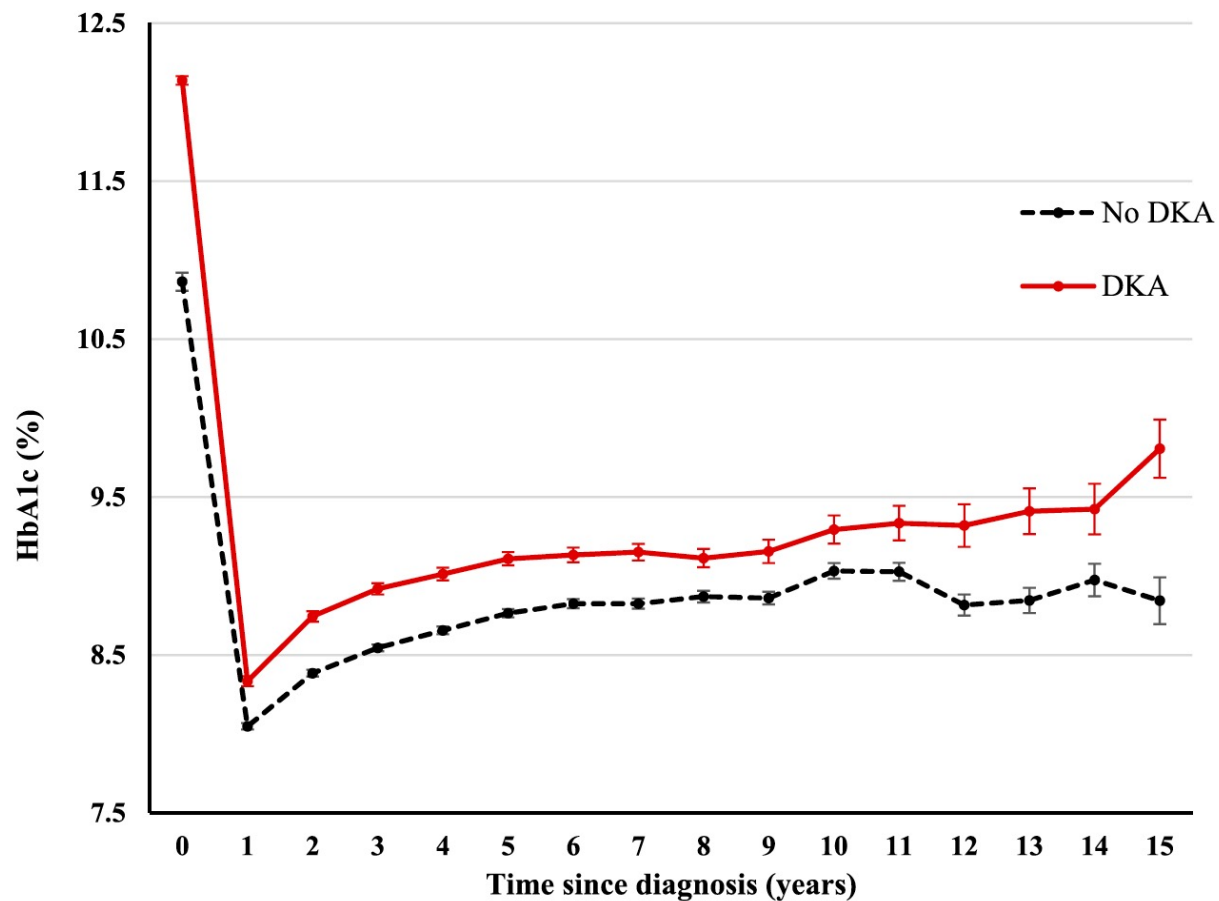


A single episode of moderate/severe DKA in young children at diagnosis is associated with lower cognitive scores and altered brain growth

Cognitive Score		Group effect at T _b		Group effect at T ₁₈		Group effect at T ₁₈ vs. T _b	
		Estimate	p value	Estimate	p value	Estimate	p value
IQ	Subscale						
	Full Scale IQ Child Standard Score	-3.99	0.136	-5.816	0.003	-1.86	0.342
	Vocabulary Child Scale Score	-1.384	0.014	-0.613	0.279	0.771	0.15
Executive functions	Detectability T-Score	0.505	0.79	3.901	0.038	3.395	0.122
	Commission T-Score	1.447	0.432	4.861	0.008	3.415	0.088
Learning & Memory	Word List Delayed Recognition Score	-2.039	0.002	-0.559	0.391	1.48	0.101
	Dots Location Immediate Raw Score	0.005	0.986	-0.602	0.033	-0.607	0.087
	Dots Location Delayed Raw Score	0.226	0.432	-0.659	0.023	-0.886	0.021

Significantly lower Full Scale Intelligence Quotient scores, cognitive performance on the Detectability and Commission subtests

DKA at diagnosis of type 1 diabetes in children predicts poor long-term glycemic control, independent of demographic and socioeconomic factors



Data from a prospective cohort study of 3,364 Colorado residents

Health Care Utilization and Burden of Diabetic Ketoacidosis in the U.S. Over the Past Decade: A Nationwide Analysis

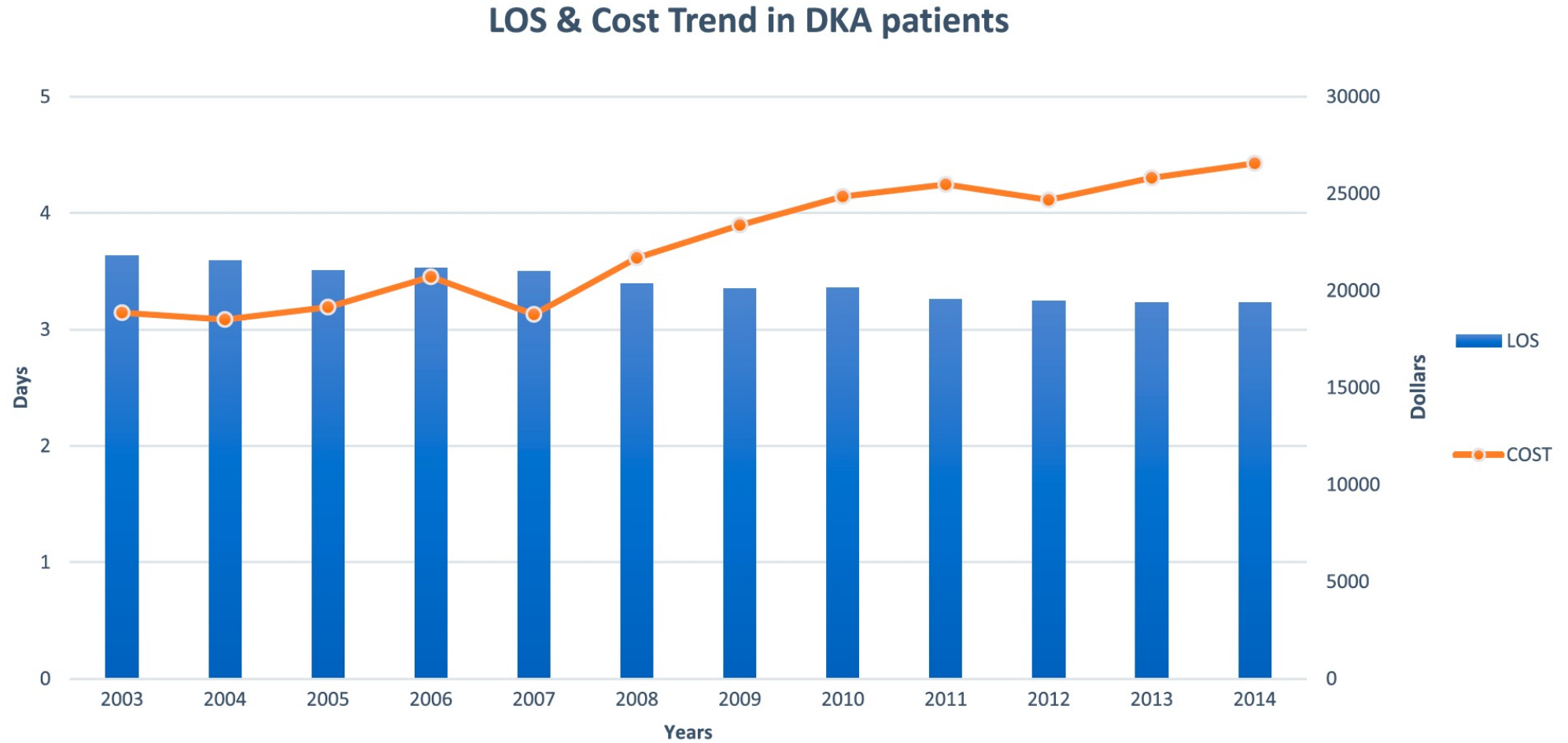


Figure 2—Length of stay (LOS) and mean cost of each hospitalization for patients with DKA.



Quanto è frequente la DKA?

Lesioni permanenti e mortalità

SCIENTIFIC REPORTS

OPEN

High frequency of diabetic ketoacidosis at diagnosis of type 1 diabetes in Italian children: a nationwide longitudinal study, 2004–2013

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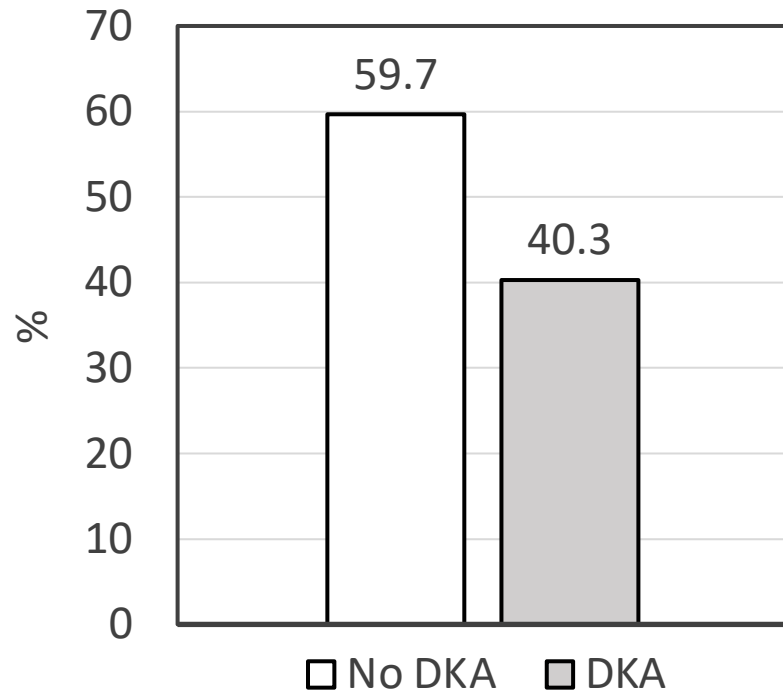
Valentino Cherubini¹, Edlira Skrami², Lucia Ferrito¹, Stefano Zucchini³, Andrea Scaramuzza⁴, Riccardo Bonfanti⁵, Pietro Buono⁶, Francesca Cardella⁷, Vittoria Cauvin⁸, Giovanni Chiari⁹, Giuseppe d'Annunzio¹⁰, Annapaola Frongia¹¹, Dario Iafusco¹², Ippolita Patrizia Patera¹³, Sonia Toni¹⁴, Stefano Tumini¹⁵, Ivana Rabbone¹⁶, Fortunato Lombardo¹⁷, Flavia Carle², Rosaria Gesuita² & Diabetes Study Group of the Italian Society for Pediatric Endocrinology and Diabetology (ISPED).#

New diagnosis of T1D < 15 years
9,040 cases

Permanent neurological damages
7 cases

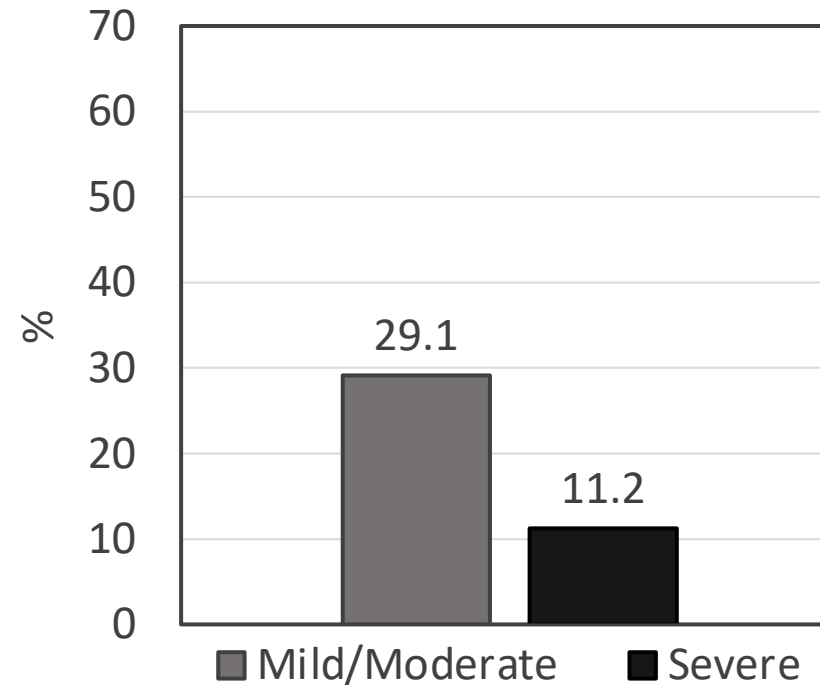
Deaths related to T1D
4 cases

High frequency of DKA at diagnosis of type 1 diabetes in Italy: 2004-2013



No DKA=5,394

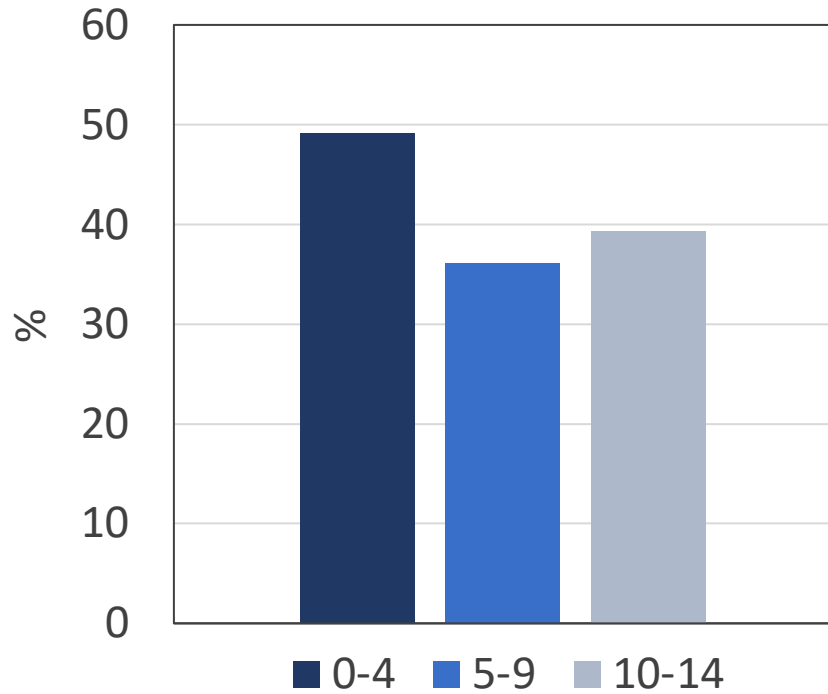
DKA=3,646



Mild/Moderate=2,633

Severe=1,013

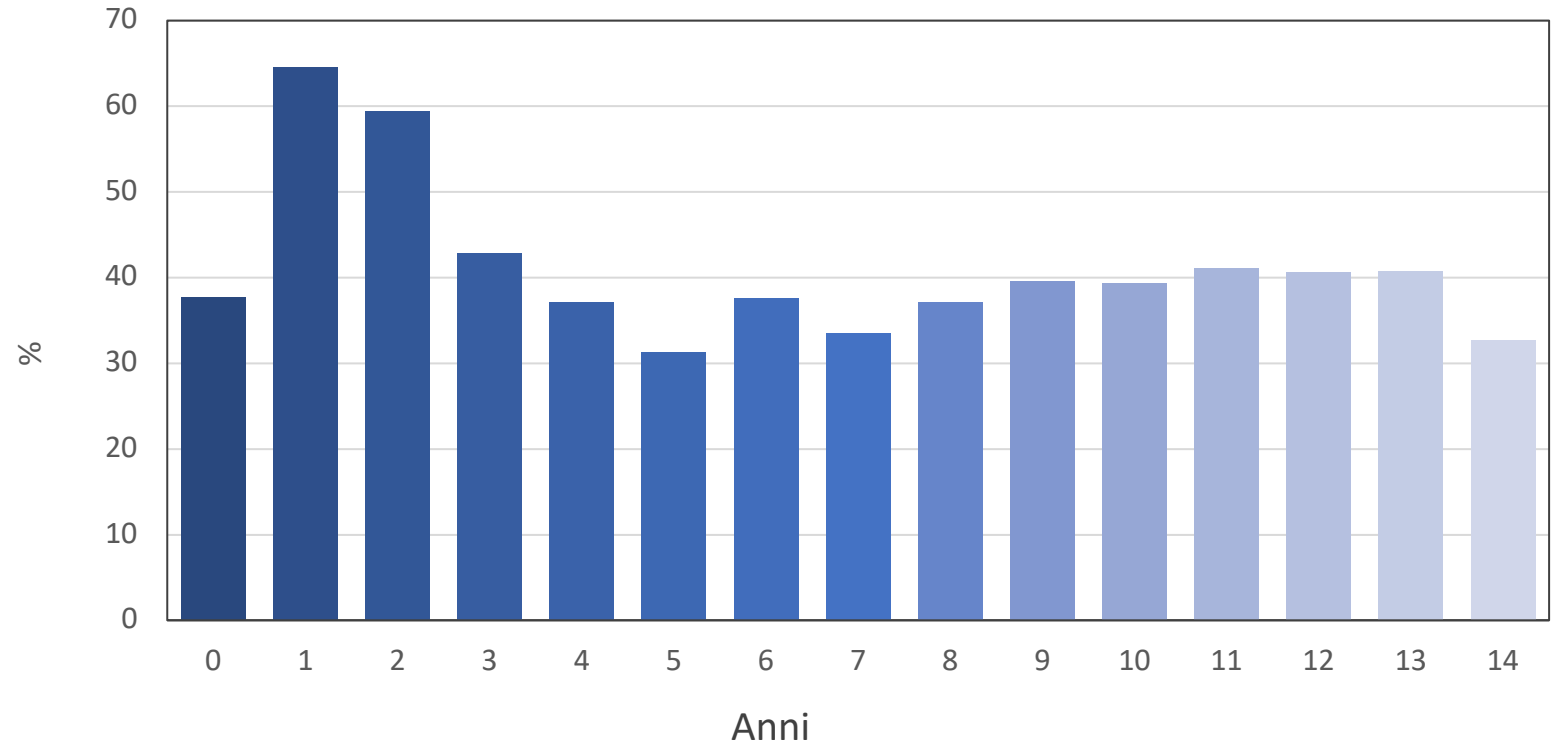
High frequency of DKA at diagnosis of type 1 diabetes in Italy: 2004-2013



0-4 anni=1,030

5-9 anni=1,258

10-14 anni=1,358



Temporal trends in diabetic ketoacidosis at diagnosis of T1D between 2006-2016: results from 13 countries in 3 continents

Table 1 Cases of type 1 diabetes, DKA prevalence and standardised DKA prevalence, at type 1 diabetes diagnosis across the study population between 2006 and 2016

Country	New diagnosis of type 1 diabetes (<i>n</i>)	DKA prevalence, % (95% CI)	Standardised DKA prevalence, % (95% CI) ^a
Australia (ADDN)	4428	24.9 (23.6, 26.2)	24.9 (23.4, 26.4)
Austria	1504	38.0 (35.6, 40.5)	37.7 (34.6, 40.7)
Czechia	2261	28.8 (27.0, 30.7)	28.6 (26.4, 30.8)
Denmark	3084	20.7 (19.3, 22.1)	20.8 (19.1, 22.4)
Germany	19,127	26.8 (26.2, 27.4)	26.8 (26.1, 27.5)
Italy	10,317	41.2 (40.3, 42.2)	41.2 (39.9, 42.4)
Luxembourg	192	43.8 (36.9, 50.9)	43.8 (34.5, 53.2)
New Zealand (Auckland)	670	26.3 (23.1, 29.7)	26.3 (22.4, 30.2)
Norway	3331	22.1 (20.7, 23.5)	22.1 (20.5, 23.7)
Slovenia	471	40.3 (36.0, 44.8)	39.9 (34.2, 45.6)
Sweden	6457	19.5 (18.6, 20.5)	19.5 (18.4, 20.6)
USA (SEARCH)	5485	36.9 (35.6, 38.1)	37.0 (35.4, 38.6)
UK (Wales)	1673	25.0 (23.0, 27.2)	25.0 (22.6, 27.4)
All countries combined	59,000	29.2 (28.8, 29.6)	

^a Standardised on whole study population

Socioeconomic Inequalities Increase the Probability of Ketoacidosis at Diagnosis of Type 1 Diabetes: A 2014–2016 Nationwide Study of 2,679 Italian Children

OPEN ACCESS

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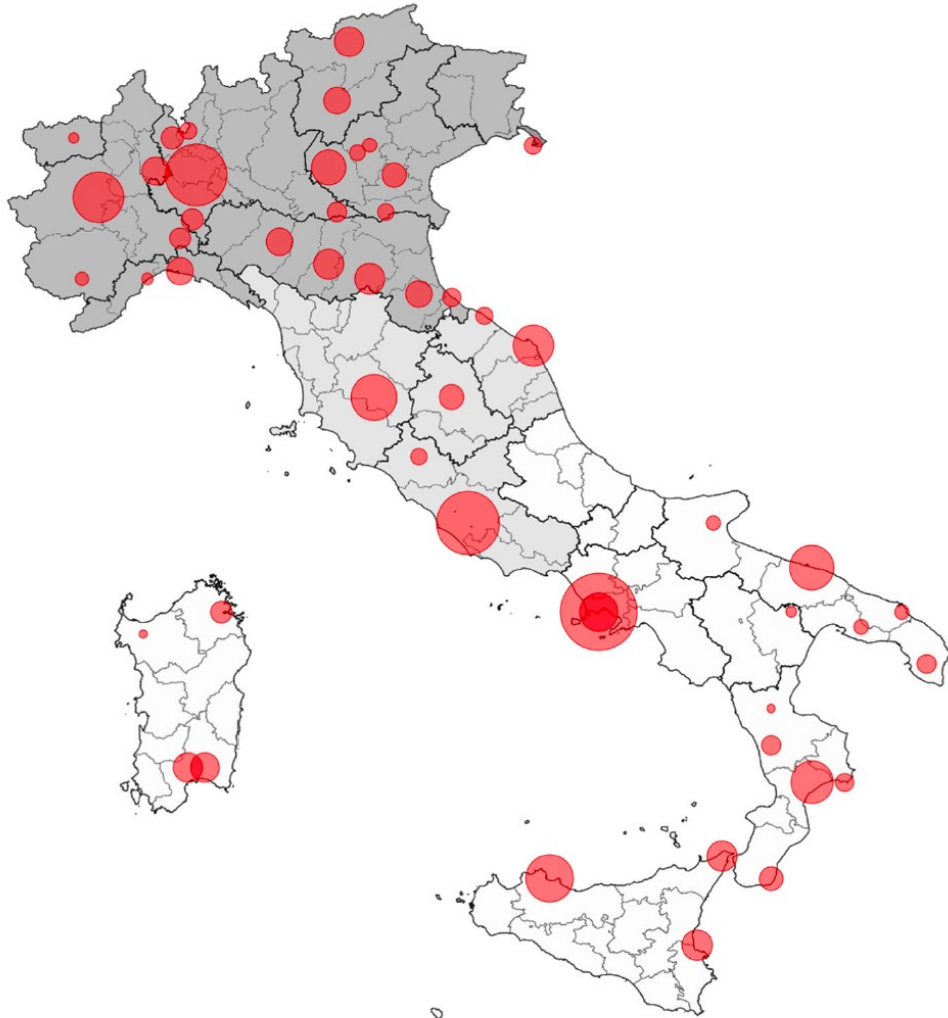
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Rosaria Gesuita¹, Claudio Maffei², Riccardo Bonfanti³, Francesca Cardella⁴, Felice Citriniti⁵, Giuseppe D'Annunzio⁶, Adriana Franzese⁷, Dario Iafusco⁸, Antonio Iannilli⁹, Fortunato Lombardo¹⁰, Giulio Maltoni¹¹, Ippolita Patrizia Patera¹², Elvira Piccinno¹³, Barbara Predieri¹⁴, Ivana Rabbone¹⁵, Carlo Ripoli¹⁶, Sonia Toni¹⁷, Riccardo Schiaffini¹², Renee Bowers¹⁸, Valentino Cherubini^{9*} and Network of the Italian Society of Pediatric Endocrinology and Diabetes (ISPED) for DKA Study and Prevention

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This study aims to compare the frequency of Diabetic Ketoacidosis (DKA) at diagnosis in 2014–2016 with the one previously reported in 2004–2013; and to assess the association between socioeconomic inequalities and DKA at diagnosis in children with Type 1 Diabetes (T1D).

Study period 2014-2016



- 54 centers
- 2679 cases
- Children with new onset T1D <15y

Main results

1. Decrease in frequency of DKA vs. 2004-2013
2. DKA frequency was still unacceptable high (36.9%)
3. Socioeconomic inequalities increased the risk of DKA at diabetes onset.

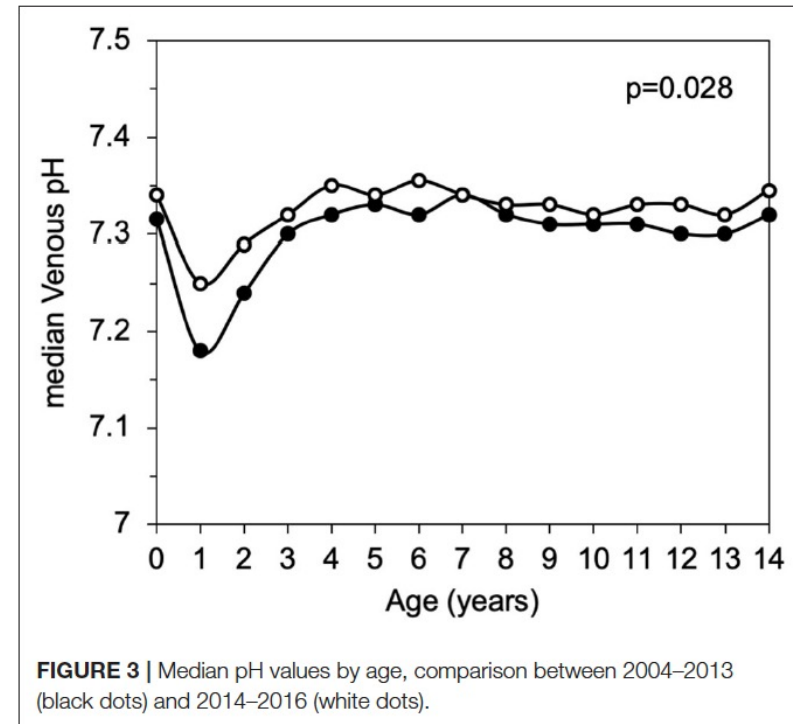


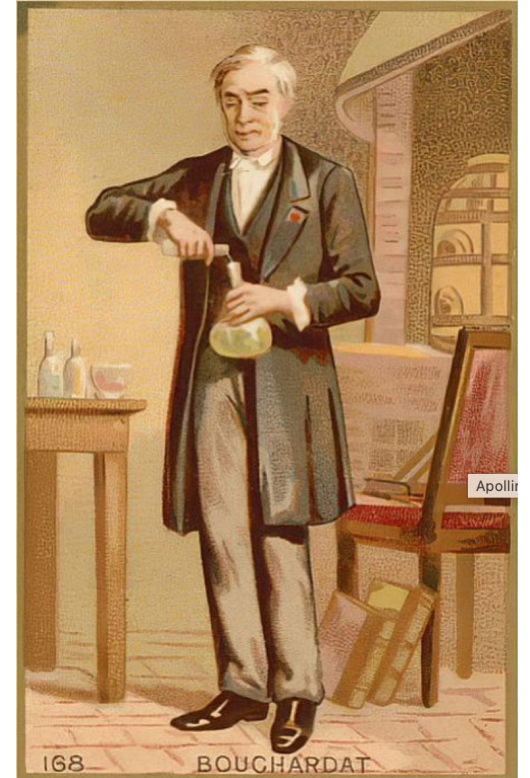
FIGURE 3 | Median pH values by age, comparison between 2004–2013 (black dots) and 2014–2016 (white dots).

Early links between covid-19 and pediatric diabetes

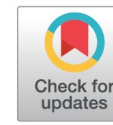
- Naples, March 15th 2020, a girl showed clear signs of polyuria and polydipsia for a week.
- Her parents, both physicians, suspected that she had T1D and discussed the need for a urinalysis to test for glucose and ketones. However they were hesitant to take her to the hospital for fear of COVID-19.
- The girl tasted her urine, confirming the presence of sweet-tasting glucose.



Cases of delayed diabetes diagnosis leading to severe DKA have also been reported during the first few weeks after the onset of COVID-19 in California, and Indiana, US.



Apollinaire Bouchardat (1809-1886) taught patients to taste their own urine



Has COVID-19 Delayed the Diagnosis and Worsened the Presentation of Type 1 Diabetes in Children?

Ivana Rabbone,¹ Riccardo Schiaffini,² Valentino Cherubini,³ Claudio Maffei,⁴ Andrea Scaramuzza,⁵ and the Diabetes Study Group of the Italian Society for Pediatric Endocrinology and Diabetes*

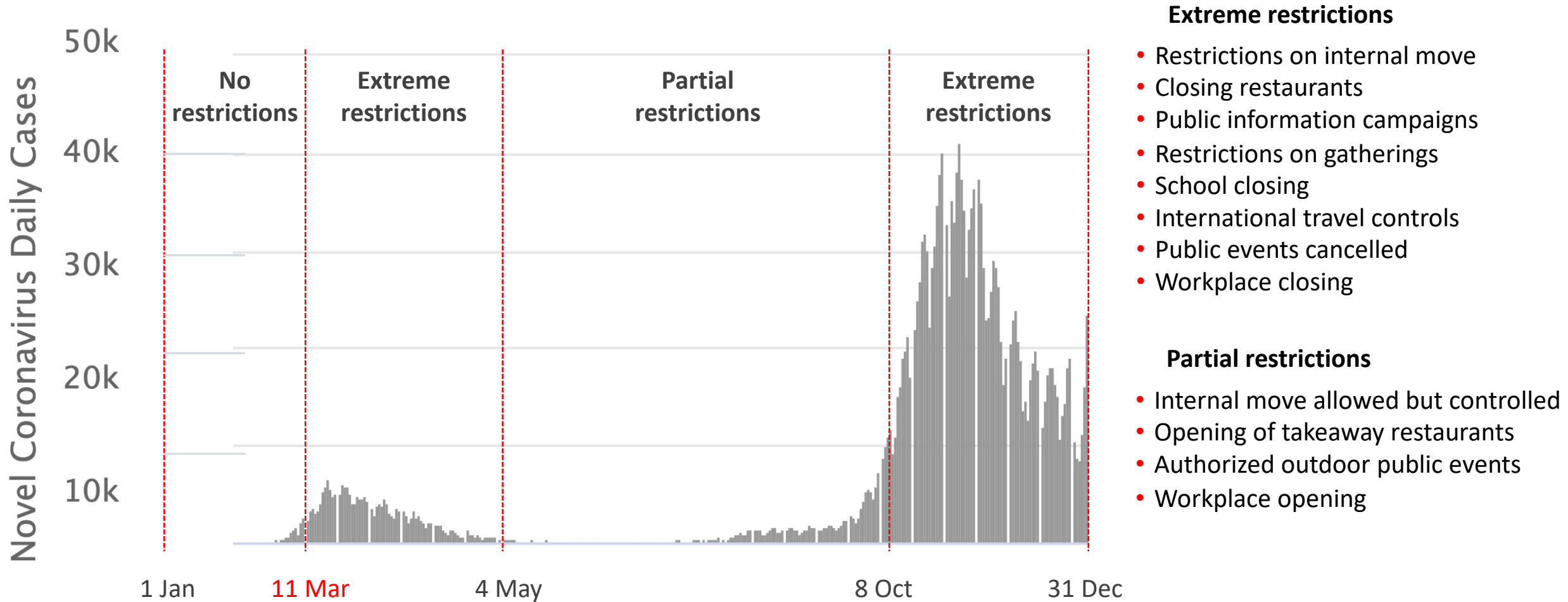
Diabetes Care 2020;43:2870–2872 | <https://doi.org/10.2337/dc20-1321>

Table 1—Diabetes onset, DKA at onset, and acute complications in the pediatric population (0–15 years) observed during COVID-19 pandemic (20 February–14 April 2020) compared with the same period in 2019

	2020		2019		Δ	<i>P</i>
	<i>n</i>	%	<i>n</i>	%		
Patients with diabetes onset	160	—	208	—	–48	–
Patients with DKA (pH <7.3)	61	38.1	86	41.3	–3.2	0.08
Patients with severe DKA (pH <7.1)	27	16.9	31	14.9	2.0%	0.09
Proportion of DKA patients with severe DKA	27	44.3	31	36.0	8.3%	0.03
DKA episodes in patients with established diabetes	13	—	22	—	–9	—
Severe hypoglycemia episodes in patients with established diabetes	10	—	13	—	–3	—



Number of new daily COVID-19 cases in Italy in 2020 during various restriction measures



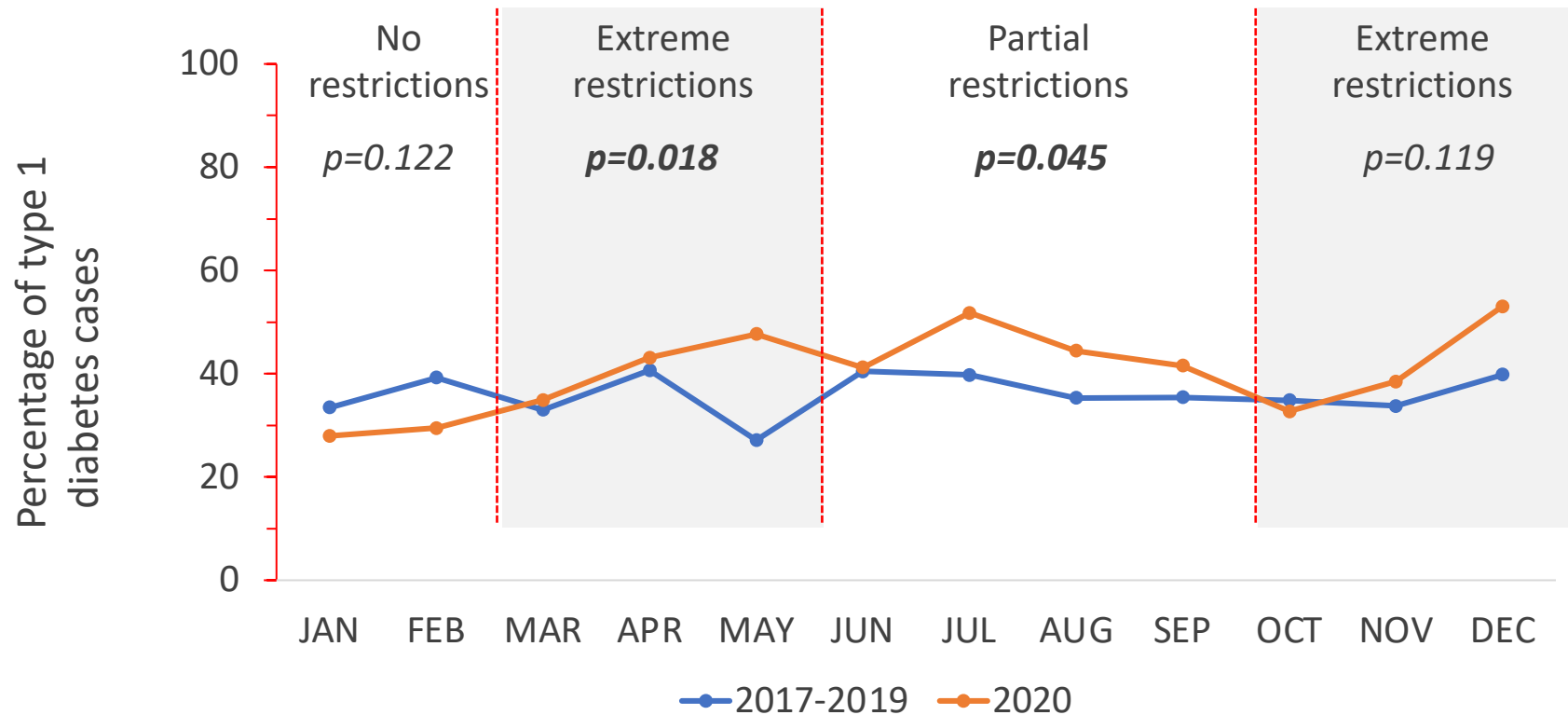
Extreme restrictions

- Restrictions on internal move
- Closing restaurants
- Public information campaigns
- Restrictions on gatherings
- School closing
- International travel controls
- Public events cancelled
- Workplace closing

Partial restrictions

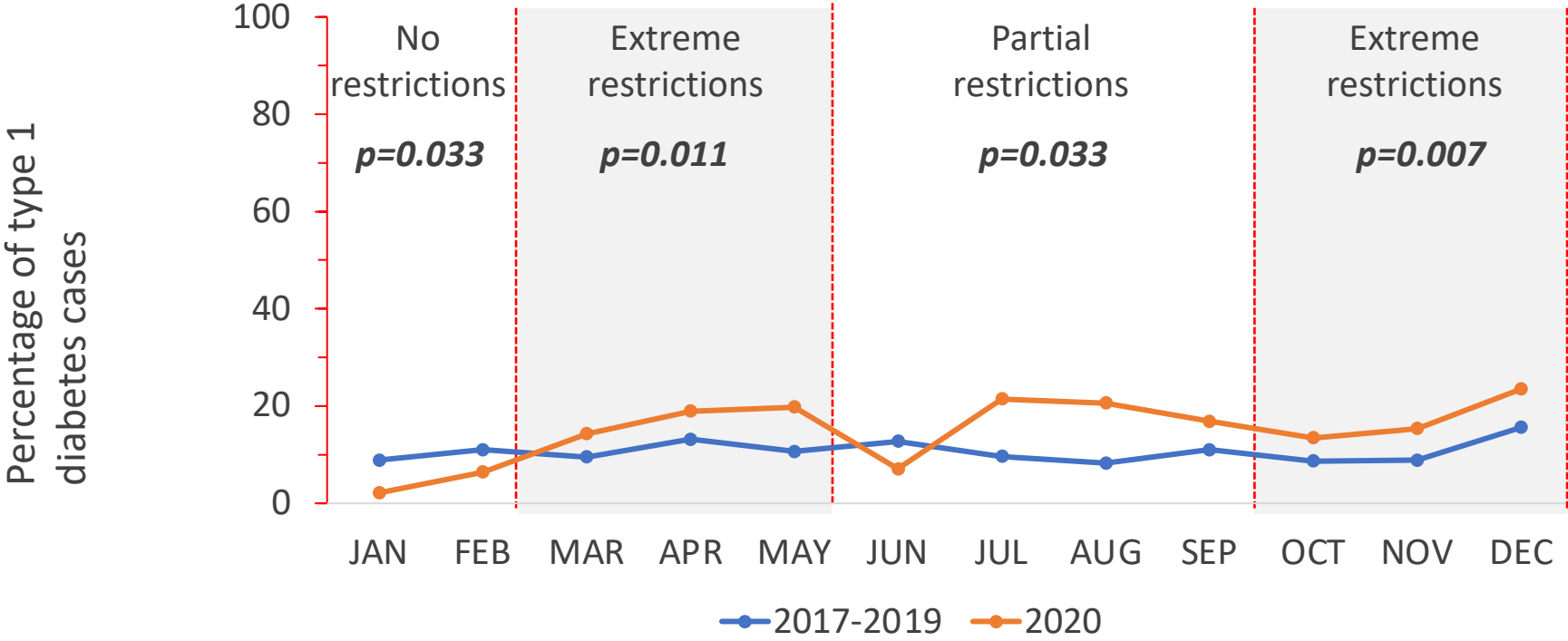
- Internal move allowed but controlled
- Opening of takeaway restaurants
- Authorized outdoor public events
- Workplace opening

Yearly Comparison of T1D diagnosis and DKA frequency in Italy



Cases of type 1 diabetes <15 y
40 Pediatric Diabetes Centres
2017-2019 2398 cases
2020 965 cases

T1D at diagnosis and severe DKA (pH<7.10) frequency in Italy



Cases of type 1 diabetes <15 y
40 Pediatric Diabetes Centres
2017-2019 2398 cases
2020 965 cases

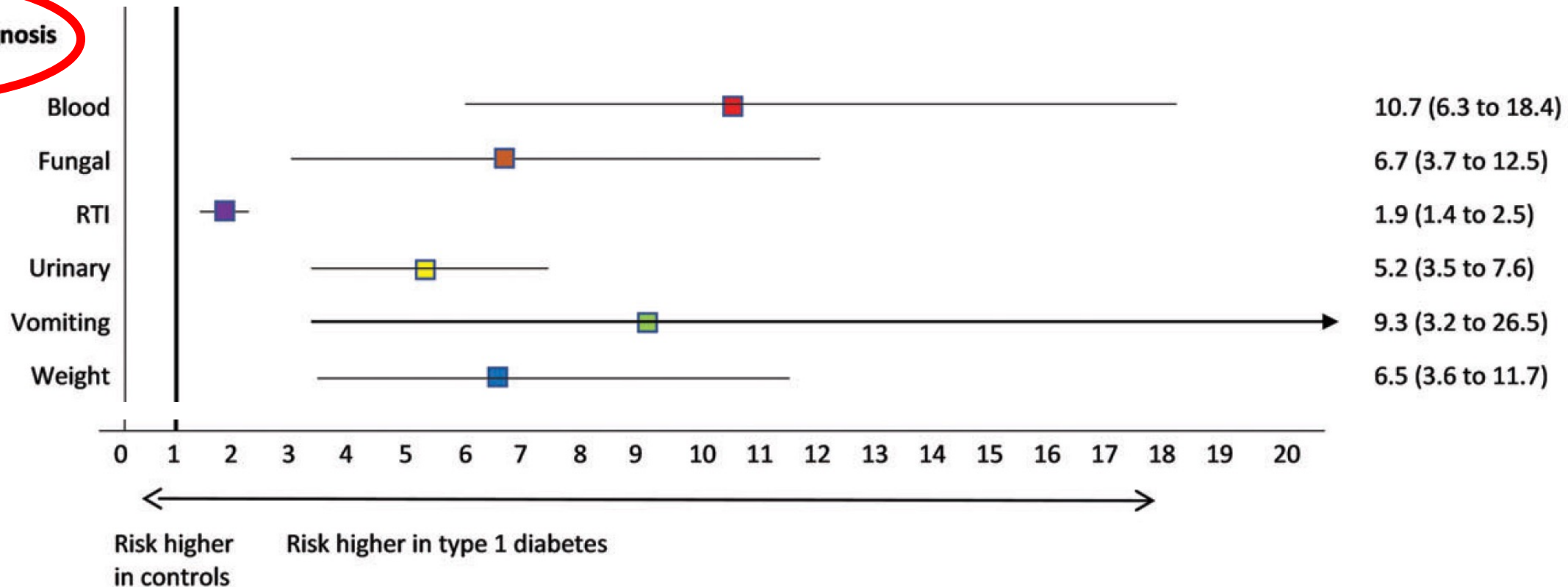
The image shows a clinical setting with various medical devices. On the left, an IV drip chamber is suspended from a stand. In the center, a ventilator is connected to a patient's airway. To the right, a large graduated container is visible. The background is a plain wall with a power outlet and a control panel. A red banner is overlaid at the bottom of the image.

E' possibile prevenire la DKA?

Presentation to primary care during the prodrome of T1D

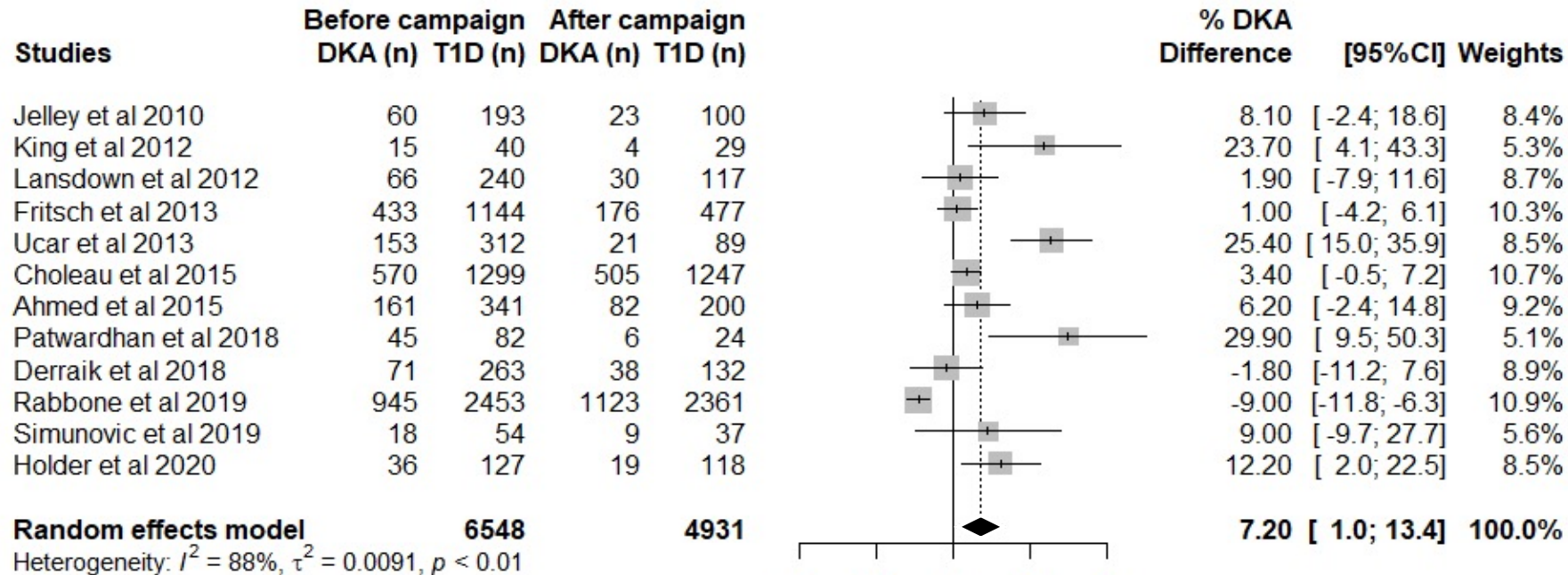
Opportunity for an earlier diagnosis

1 – 30 days prior to diagnosis



Is there an effective intervention method to reduce DKA at diagnosis of type 1 diabetes in children and youth?

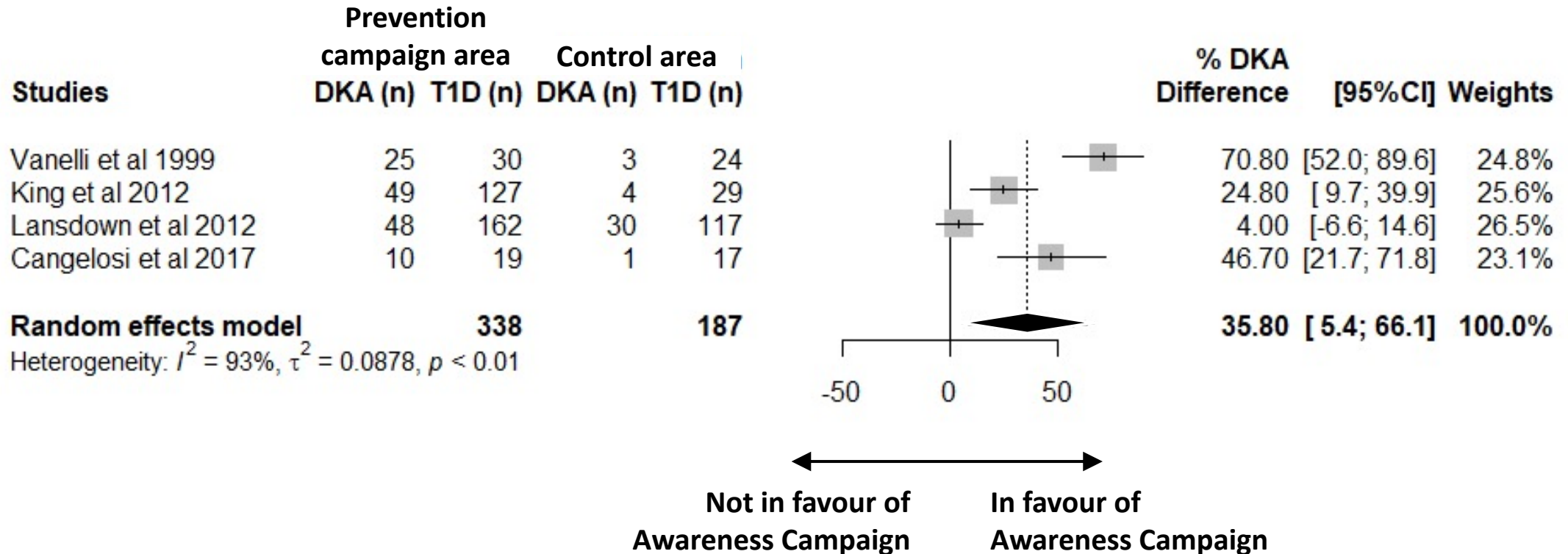
Diabetes Awareness Campaigns: same area before and after Campaign



← Not in favour of Awareness Campaign In favour of Awareness Campaign →

Is there an effective intervention method to reduce DKA at diagnosis of type 1 diabetes in children and youth?

Diabetes Awareness Campaigns: different area with and without Campaign



Sei punti essenziali per la prevenzione

1. Sensibilizzazione sugli operatori sanitari (continua)
2. Sensibilizzazione sull'opinione pubblica (continua).
3. Stick glicemico al TRIAGE pediatrico di Pronto Soccorso in tutti i bambini.
4. Collaborazione con le farmacie per stick glicemico nel sospetto di diabete.
5. Se prescritti esami ematochimici, il laboratorio deve informare immediatamente il medico di una glicemia alterata.
6. Una volta individuato un nuovo caso di diabete in un bambino, la gestione dovrebbe essere sempre affidata a un «pediatra diabetologo senior».



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**...in molti casi
la DKA può essere evitata**