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Perceptions and understanding of family pediatricians regarding the new Italian Type 1 Diabetes screening program

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ABSTRACT

Aims: Italy is the first country to implement a nationwide Type 1 Diabetes (T1D) screening program aimed at reducing cases of diabetic ketoacidosis and potentially delaying disease progression through early interventions. This study assesses the knowledge, perceptions, and willingness of family pediatricians (FPs) to participate in this program.

Methods: An anonymous online survey was conducted among 113 FPs in the Friuli Venezia Giulia region, an area not included in the initial pilot study. The survey evaluated their knowledge, readiness, and concerns regarding the screening program.

Results: Of the 62 respondents (55% response rate), 84% expressed a willingness to participate in the screening program, although most reported limited knowledge about it. The key concerns included family anxiety, identifying individuals at risk of diabetes, and uncertainty regarding follow-up procedures. While FPs acknowledged the potential benefits of reducing ketoacidosis, 75% emphasized the need for more training and support.

Conclusions: While FPs are largely willing to participate in the T1D screening program, significant gaps in knowledge and preparedness remain. Addressing these gaps through comprehensive education and clear follow-up protocols is crucial for the successful nationwide implementation of the program in 2025.

1. Introduction

Italy is the first country to introduce a legal mandate for nationwide screening for Type 1 Diabetes (T1D) in children, with the goal of reducing the incidence of diabetic ketoacidosis (DKA) through early detection and potentially exploring therapies to slow the disease's progression [1]. T1D has a prevalence of approximately 0.5 % in the Italian population, affecting around 300,000 people [2]. This screening initiative, which is set to expand nationally in 2025, is currently in a pilot phase known as the D1Ce study, being carried out in four regions: Campania, Lombardy, Marche, and Sardinia. Approximately 5,000 children are participating in this initial phase [3,4].

The screening will be conducted by pediatric primary care physicians, also known as family pediatricians (FPs), who will play a central role in its implementation. FPs are contracted directly by the National Health System under a capitated payment model but operate independently in their practices, providing both acute and chronic care free of charge to children from birth to 14 years of age [5]. Their responsibilities in the screening program include reaching out to families, providing detailed information, obtaining informed consent, submitting data to a central platform managed by the Italian National Institute of Health, and collecting blood samples from the children. While the pediatricians' participation in the program is voluntary, they will receive financial compensation for their involvement. Family participation will be entirely voluntary, allowing parents to decide whether to have their children undergo the screening.

Despite these initial steps, important questions remain regarding how the program will be effectively scaled on a national level, particularly concerning the long-term roles of FPs and how to maintain their involvement. Additionally, it is crucial to assess whether FPs are adequately prepared and informed about the program's objectives and implementation.

Abbreviations: DKA, diabetic ketoacidosis; FP, family paediatrician; IQR, interquartile range; T1D, type 1 diabetes.

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No studies have yet addressed this issue, as Italy is the first country to introduce such a nationwide screening program by law.

The aim of this study is to evaluate the perceptions, knowledge, and attitudes of FPs in a region not yet involved in the pilot phase, in order to identify potential challenges and areas for improvement ahead of the nationwide rollout.

2. Methods

A survey tool was developed using a systematic, step-by-step approach to create the questions. The initial list contained 24 questions, which were reviewed for face and content validity by three independent researchers (J.M., S.S., and G.To.). Each researcher evaluated the content independently, focusing on accuracy, wording, question order, and overall survey structure. After reviewing, they reached a consensus on the final list of questions. To ensure clarity and user-friendliness, a preliminary version of the survey, consisting of ten questions, was piloted with a small sample of three pediatricians who were not involved in diabetes care. Feedback from this pilot indicated that the questions were clear, the wording was straightforward, and the self-administration process was successful.

The final self-administered questionnaire was divided into 12 sections, covering topics such as: general demographic data (including the number of children and adolescents followed by the pediatricians, and how many had T1D), knowledge and awareness of the screening program, perceived benefits and concerns, the target population, the implications of antibody positivity, the feasibility of screening in family pediatric practices, and the pediatricians' willingness to participate (details available in the Supplementary file).

The study aimed to recruit all FPs in the Friuli Venezia Giulia region, which has a population of approximately 1.2 million people, including about 180,000 individuals under 18. This region was chosen as it is not involved in the pilot study [4]. The names and email addresses of the FPs were obtained from public records on local health authority websites.

The survey was administered online using a commercially available platform (Google Forms). Data collection took place over a three-week period, from September 7th to September 28th, 2024. An email reminder was sent two weeks after the initial invitation to encourage participation. Each FP received an email containing a link to the survey, along with a brief introduction explaining the study's purpose, data handling procedures, an informed consent statement, an invitation to complete the survey, and an introduction to the authors. By clicking the survey link, respondents consented to participate.

Participation was entirely voluntary, with no incentives offered. Respondents had the option to review and modify their answers before submitting them using a back button. Survey responses were downloaded and securely stored on an encrypted computer, accessible only to the study authors throughout all stages of the research. The survey was conducted anonymously to ensure participants' privacy.

Data are presented as the median and interquartile range (IQR) for continuous variables and as absolute frequency and percentage for categorical variables. In addition to analyzing overall responses, we conducted subgroup analyses based on specific characteristics of the respondents. These analyses included comparisons by sex, age, whether or not the FPs reported seeing children or adolescents with T1D in their practice, and, if applicable, the number of patients with T1D seen by each FP. Differences among continuous variables were evaluated using the Kruskal-Wallis test for non-normally distributed variables, while the chi-square test was used to assess differences among categorical variables. A P value < 0.05 was considered statistically significant. All statistical analyses were performed with jamovi (version 2.3.28).

3. Results

A total of 62 FPs (55 %) responded to the survey, 82 % of whom were female—a proportion not statistically different from the overall percentage of female FPs (79 %, $p = 0.47$). Respondents had a median age of 49.5 years (IQR 43.0–60.0), and had a median patient load of 1,000 children (IQR 882–1,094).

Forty-eight FPs (77 %) had at least one child or adolescent with T1D (median 2 [IQR 1–3]), and collectively, the respondents cared for 104 children and adolescents with T1D, representing about one-third of the estimated prevalent cases in the region [6].

3.1. Knowledge and awareness of screening program

The majority of FPs reported limited awareness of the new screening program, with 24 % stating they knew nothing about it and 52 % indicating they knew only a little. Only 24 % felt they had sufficient knowledge, and none claimed to have a deep understanding. Moreover, 26 % of respondents were unaware of their role in the screening process, while 73 % did not feel adequately prepared to fulfill their responsibilities (Fig. 1). All respondents expressed a desire for more theoretical and practical information about the program.

3.2. Benefits of the screening program

When asked about the benefits of screening, 95 % of FPs highlighted its potential to reduce cases of diabetic ketoacidosis [7,8]. Additionally, 44 % noted that screening could give patients and families more time to adjust to the diagnosis, while 27 % pointed to the potential to delay onset in high-risk individuals through pharmacological interventions (Fig. 2). Some FPs also mentioned the importance of raising awareness and initiating treatment early as key benefits of screening. However, there were notable misconceptions: 19 % of FPs mistakenly believed that a negative result would permanently rule out the possibility of developing T1D, and 3 % incorrectly thought that screening could reduce the overall incidence of the disease.

3.3. Concerns about the screening program

Despite the perceived benefits, 11 % of FPs did not believe the screening would be useful. Among the primary concerns were increased anxiety among families (86 %), the possibility of identifying at-risk individuals who might never develop the disease (69 %), and the lack of available treatments in Italy to definitively prevent T1D (53 %). Additional concerns included the unclear cost-benefit ratio (39 %) and the need for repeated antibody testing over the years (31 %), which could miss cases diagnosed before or after seroconversion (Fig. 2) (6,7). Furthermore, some FPs worried that knowing a child's predisposition might lead to overprotective behaviors or inappropriate lifestyle choices. FPs who did not see family anxiety as a major issue typically had more experience managing children with T1D (median 2 [IQR 1;4] vs. 1 [IQR 0;2], $p = 0.047$); those concerned about the burden of antibody testing tended to manage larger patient loads (median 1,070 [IQR 984;1140] vs. 990 [IQR 880;1000], $p = 0.024$) (Fig. 3).

3.4. Target population

Seventy-six percent of the FPs understood that the screening was intended for the general population [9]. However, 13 % believed it was only for relatives of individuals with T1D, and 11 % thought it was for families with any autoimmune condition. Moreover, only 39 % of respondents correctly identified that having a family history of T1D increases the risk up to 15-fold compared to the general population [10], while 61 % underestimated this risk. Regarding the timing of the screening, 73 % and 63 % correctly identified the ages of 2 and 6 years, respectively [11–13], while 40 % also indicated 10 years, which was initially considered for the screening [4].

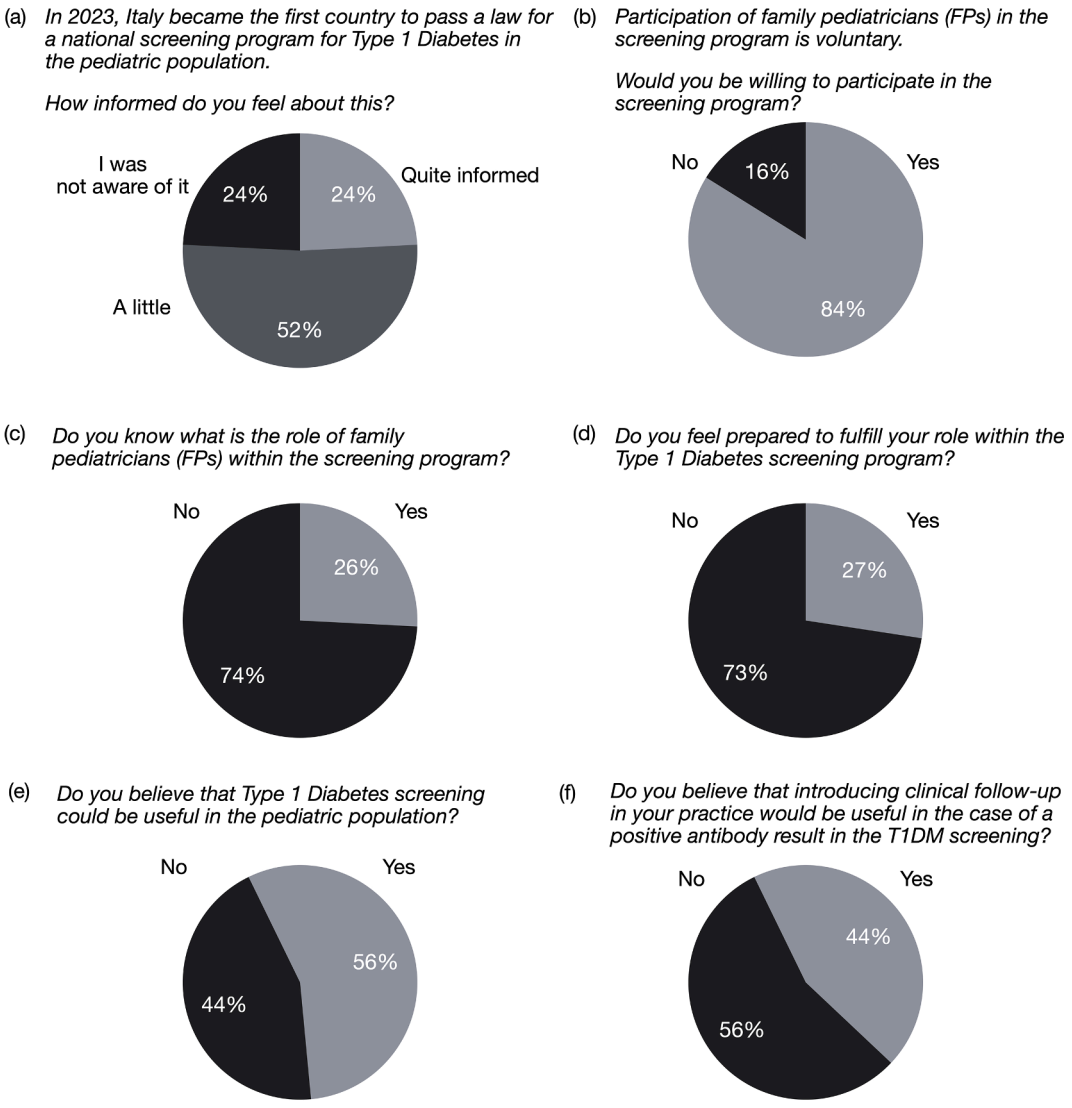

Fig. 1. Family Pediatricians' (FPs) Knowledge, Perceptions, and Preparedness Regarding the Italian Type 1 Diabetes Screening Program. *(a) Awareness of the 2023 law implementing a national screening program for Type 1 Diabetes in the pediatric population. (b) Willingness of FPs to participate in the voluntary screening program. (c) Knowledge of the role of FPs within the screening program. (d) Preparedness to fulfill their role in the Type 1 Diabetes screening program. (e) Perception of the usefulness of Type 1 Diabetes screening in the pediatric population. (f) Belief in the utility of introducing clinical follow-up in FP practice in case of a positive antibody result in the screening.*

3.5. Meaning of antibodies positivity

Only 37 % knew that at stage 1, the risk of developing T1D is 44 % at 5 years and 80–90 % at 15 years, while 47 % were aware that at stage 2, the risk is 75 % at 5 years and 100 % at 15 years [8]. When asked about the presence of a single positive antibody, 52 % indicated it could signify the onset of seroconversion, while 15 % thought it could be transient. Additionally, 45 % estimated the risk of developing T1D to be 10–15 % [8], but 11 % incorrectly believed the risk was comparable to that of the general population.

3.6. Screening in FP practice

When asked how they would propose the screening to families, 95 % of FPs said they would introduce it during routine health check-ups [11]. Other methods suggested included using posters in the office (53 %) or brochures (34 %), contacting families via phone (16 %) or e-mail (8 %), and discussing the screening during flu vaccinations or consultations for other conditions. Some FPs also suggested holding group meetings or placing posters at vaccination centers. Only 58 % of respondents were familiar with the role of the health visitor ("assistente sanitario") [14], a professional dedicated to prevention, health promotion, and education across all age groups. A significant 94 % of FPs believed that health visitors could play a crucial role in promoting and implementing the screening program. When it came to the follow-up care for children identified as positive during the screening, 56 % of the FPs expressed confidence in managing it within their own practices. The remaining FPs acknowledged that ongoing monitoring should be conducted by pediatric diabetes teams at the regional level [3]. Interestingly, older FPs felt more confident about managing follow-up compared to their younger counterparts. The median age of those who felt more confident in conducting follow-up was 53.0 years (IQR 44.3–61.8), while the median age for those who felt less confident was 47.0 years (IQR 41.0–55.0), showing a statistically significant difference ($p = 0.048$).

3.7. Willingness to participate in the screening program

Despite the concerns raised, 84 % of FPs expressed a willingness to participate in the program. However, many noted that they were already dealing with heavy workloads, and some were hesitant to take on additional responsibilities. Commonly cited challenges included a lack of knowledge about the screening process, difficulty balancing acute

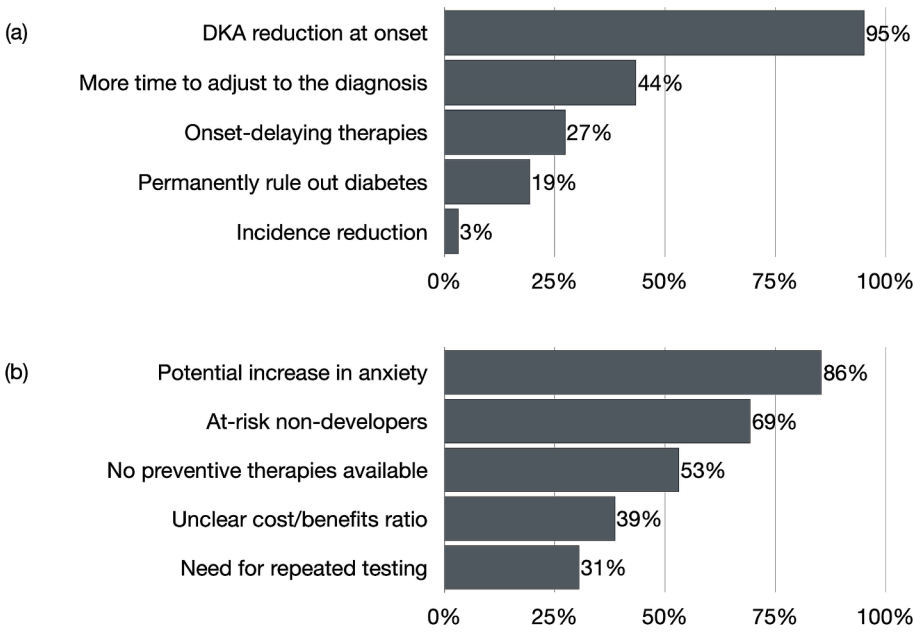

Fig. 2. Pros and cons of the Type 1 Diabetes screening program according to family pediatricians (FPs). Multiple answers were allowed. *(a) Benefits of the screening (Note: "permanently rule out diabetes" and "incidence reduction" are incorrect). (b) Concerns about the screening.*

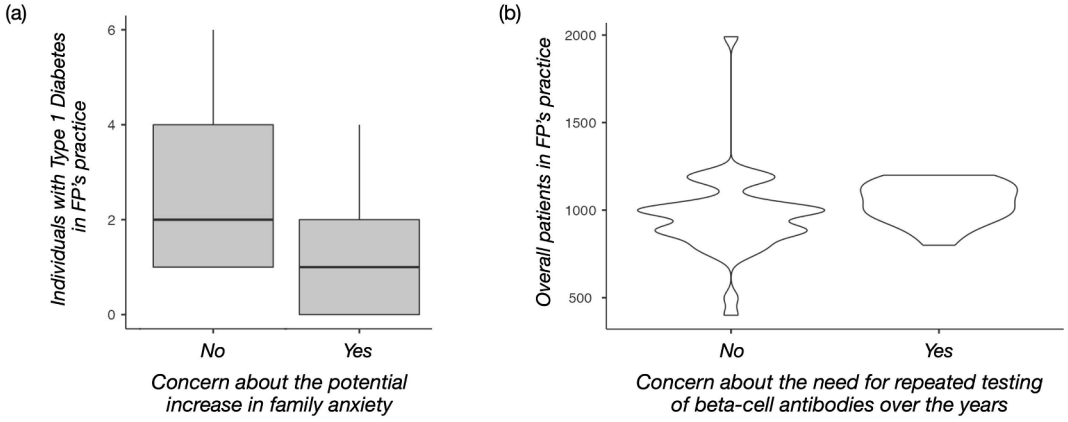

Fig. 3. Association between concerns related to Type 1 Diabetes screening and characteristics of Family Pediatricians (FPs). *(a) Boxplot showing the number of individuals with Type 1 Diabetes followed by FPs in relation to concerns about the potential increase in family anxiety. (b) Violin plot illustrating the overall number of patients under the care of FPs in relation to concerns about the need for repeated testing of beta-cell antibodies over the years.*

care with preventive tasks, and limited time. Some FPs also expressed concerns about the lack of follow-up protocols, uncertainty about how children would perceive the testing, and the involvement of the national healthcare system. A few respondents suggested that resources for screening might be better allocated to other healthcare needs.

4. Discussion

This survey highlights for the first time both the opportunities and challenges faced by FPs in implementing a T1D screening program. Conducted in Italy—the first country to pass a law making T1D screening accessible to all children and adolescents—this study provides unique insights into FP perspectives.

The findings indicate that 84 % of the responding FPs expressed a willingness to participate in the program; however, when this is considered as a percentage of all FPs (46 %), it is lower than the actual participation rate in Bavaria's presymptomatic T1D screening program (66 %) [15,16]. This contrast suggests that, despite high expressed willingness, actual participation rates in similar programs may differ, underscoring the need for real-world engagement data. Notably, 75 % of FPs reported limited or no knowledge of the screening process, and were unaware of their specific role. Many expressed hesitation to participate without additional training and support. Significant knowledge gaps were identified, particularly regarding key aspects of the screening, such as identifying target populations [9], interpreting beta-cell autoantibodies, and understanding long-term follow-up. Additionally, some FPs indicated they would not participate in the program, and a substantial portion did not respond to the survey, highlighting the need to address these issues to ensure broader engagement.

While FPs widely recognized the benefits of screening, such as reducing DKA and enabling early intervention, concerns were raised about family anxiety, identifying at-risk individuals who may never develop the disease, the lack of preventive treatments, and the need for repeated antibody testing. Some FPs emphasized the importance of monitoring the cost-effectiveness of the screening program, particularly given the resource-intensive nature of routine T1D screening in pediatric practices. Ensuring that the program remains both clinically beneficial and financially viable will be essential to its long-term success.

Most FPs favored integrating screening during routine health check-ups [17], but careful planning is needed to ensure this does not overwhelm their existing responsibilities. The involvement of health visitors was seen as a potential solution to support the FP's workload, as nurses are not typically present in FP practice settings in Italy [5,8].

This study has several limitations. It was conducted in a single region, which may limit the generalizability of the findings to other regions in Italy or other countries. Additionally, the survey was primarily answered by FPs who already had individuals with T1D in their practice (77%). This may introduce a selection bias, as these FPs could have a higher baseline knowledge or interest in T1D management and screening compared to those without T1D patients. Future studies should aim to include a broader and more representative sample of FPs to better capture diverse perspectives on the feasibility and implementation of T1D screening programs.

Nevertheless, this study marks the first attempt to identify potential gaps in implementing the screening program within FPs' practices. It also provides a possible model or framework for new initiatives. The findings will guide the development of targeted educational programs and improve information dissemination, ultimately enhancing the screening program's effectiveness. For the program to be successful, it is crucial to provide ongoing training for FPs, address family concerns, and ensure that appropriate treatments are accessible.

Moving forward, strengthening education, offering clear screening guidance, and establishing standardized follow-up protocols will be essential. As the program expands nationwide, further evaluation will be necessary to ensure that FPs are well-prepared and motivated to implement this ambitious screening initiative effectively.

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CRediT authorship contribution statement

Johara Mari: Writing – original draft, Data curation, Conceptualization. **Sara Solidoro:** Writing – original draft, Data curation, Conceptualization. **Cinzia Braida:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Gianluca Tamaro:** Writing – review & editing, Funding acquisition, Formal analysis, Conceptualization. **Elena Faleschini:** Writing – review & editing, Supervision, Conceptualization. **Gianluca Tornese:** Writing – review & editing, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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During the preparation of this work the authors used ChatGPT in order to revise the language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.diabres.2024.111931.

References

[1] Gazzetta Ufficiale della Repubblica Italiana. Legge 15 settembre 2023, n.130. GU Serie Generale n. 226 del 27-09-2023. https://www.gazzettaufficiale.it/eli/id/2023/09/27/23G00140/sg.
[2] Ministero della Salute. Diabete mellito tipo 1. https://www.salute.gov.it/portale/nutrizione/dettaglioContenutiNutrizione.jsp?area=nutrizione&id=5546&menu=croniche.
[3] Cherubini V, Mozzillo E, Iafusco D, et al. Follow-up and monitoring programme in children identified in early-stage type 1 diabetes during screening in the general population of Italy. Diabetes Obes Metab 2024;26(10):4197–202. https://doi.org/10.1111/dom.15779.
[4] Istituto Superiore di Sanità. Il progetto D1Ce Screen. https://www.iss.it/-/il-progetto-d1ce.
[5] Del Torso S, Bussi R, DeWitt TG. Primary care pediatrics in Italy: eighteen years of clinical care, research, and teaching under a national health service system. Pediatrics 1997;99(1):E8. https://doi.org/10.1542/peds.99.1.e8.
[6] Valent F, Candido R, Faleschini E, et al. The incidence rate and prevalence of pediatric type 1 diabetes mellitus (age 0–18) in the Italian region Friuli Venezia Giulia: population-based estimates through the analysis of health administrative databases. Acta Diabetol 2016;53(4):629–35. https://doi.org/10.1007/s00592-016-0854-0.
[7] Cherubini V, Chiarelli F. Autoantibody test for type 1 diabetes in children: are there reasons to implement a screening program in the general population? A statement endorsed by the Italian Society for Paediatric Endocrinology and Diabetes (SIEDP-ISPED) and the Italian Society of Paediatrics (SIP). Ital J Pediatr 2023;49(1):87. https://doi.org/10.1186/s13052-023-01438-3.
[8] Besser REJ, Ng SM, Gregory JW, et al. General population screening for childhood type 1 diabetes: is it time for a UK strategy? Arch Dis Child 2022;107(9):790–5. https://doi.org/10.1136/archdischild-2021-321864.
[9] Neuman V, Piona C, Cudizio L, et al. Are we ready to screen for type 1 diabetes? A structured worldwide survey among healthcare providers involved in paediatric diabetes care. Diabet Med 2024;41(6):e15329.
[10] Sims EK, Besser REJ, Dayan C, et al. Screening for Type 1 Diabetes in the general population: a status report and perspective. Diabetes 2022;71(4):610–23. https://doi.org/10.2337/dbi20-0054.
[11] Ziegler AG, Bonifacio E; BABYDIAB-BABYDIET Study Group. Age-related islet autoantibody incidence in offspring of patients with type 1 diabetes. Diabetologia 2012;55(7):1937-43. doi: 10.1007/s00125-012-2472-x.
[12] Krischer JP, Lynch KF, Schatz DA, et al. The 6 year incidence of diabetes-associated autoantibodies in genetically at-risk children: the TEDDY study. Diabetologia 2015;58(5):980–7. https://doi.org/10.1007/s00125-015-3514-y.
[13] Ghalwash M, Dunne JL, Lundgren M, et al. Two-age islet-autoantibody screening for childhood type 1 diabetes: a prospective cohort study. Lancet Diabetes Endocrinol 2022;10(8):589–96. https://doi.org/10.1016/S2213-8587(22)00141-3.
[14] Gazzetta Ufficiale della Repubblica Italiana. Decreto 17 gennaio 1997, n.69. GU Serie Generale n. 72 del 27-03-1997. https://www.gazzettaufficiale.it/eli/id/1997/03/27/097G0106/sg.
[15] Raab J, Haupt F, Scholz M, et al. Capillary blood islet autoantibody screening for identifying pre-type 1 diabetes in the general population: design and initial results of the Fr1da study. BMJ Open 2016;6(5):e011144.
[16] Karl FM, Winkler C, Ziegler AG, et al. Costs of public health screening of children for presymptomatic Type 1 diabetes in Bavaria. Germany Diabetes Care 2022;45(4):837–44. https://doi.org/10.2337/dc21-1648.
[17] Dunne JL, Koralova A, Sutphin J, et al. Parent and Pediatrician preferences for Type 1 diabetes screening in the U.S. Diabetes Care 2021;44(2):332–9. https://doi.org/10.2337/dc20-0927.