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Effect of population-wide screening for presymptomatic early-stage type 1 diabetes on paediatric clinical care

Population-wide screening of children for presymptomatic early-stage type 1 diabetes is gaining momentum. Studies have demonstrated feasibility and acceptance, and shown that the rate of progression to clinical stage 3 diabetes is similar if islet autoantibody-positive early-stage type 1 diabetes is identified from general population or first-degree relative screening.[1,2] Moreover, in conjunction with an education and follow-up package, screening significantly reduces the rates of ketoacidosis, symptoms, and hospitalisation.[3] Within Europe, Italy has enacted legislation to support such screening[4] and the European Commission has funded the EDENT1FI programme to examine the feasibility of screening and follow-up in several countries.

For more on **EDENT1FI** see https://www.edent1fi.eu/

Implementation of screening and follow-up will require additional resources for paediatric care. To address this, we have modelled the numbers of children who would be identified and require follow-up in a presymptomatic stage through the introduction of general population screening at age 2·0 years and again at age 6·0 years, as suggested by Ghalwash and colleagues.[5] Modelling was based on updated frequencies of children with early-stage type 1 diabetes in the Germany-based Fr1da study[1,3] (appendix p 2).

See **Online** for appendix

A total of 188 847 children aged 2 to 11 years from February, 2015 until Jan 31, 2024 were screened. This included 76 322 children aged 1·75 to 2·5 years and 6812 children who were rescreened approximately 4 years after a negative first screen. Of these, 164 (0·21%; 95% CI 0·18–0·25) screened at age 2 years and 13 (0·19%; 0·10–0·33) of rescreened children had multiple islet autoantibody-positive early-stage type 1 diabetes. According to population statistics, there are approximately 800 000 children aged 2 years and 800 000 children aged 6 years living in Germany (appendix p 2). Modelling screening at age 2·0 years and again after 4 years at age 6·0 years with a 90% participation rate would annually yield 1512 with early-stage type 1 diabetes at age 2 years and a further 1368 at age 6 years (appendix p 4). This compares with approximately 3200 children under the age of 18 years diagnosed yearly with clinical type 1 diabetes[6] (appendix p 2).

The annual rate of progression to clinical type 1 diabetes in children with early-stage type 1 diabetes was 11% in those aged 2 years and 9% in those aged 6 years.[1] With these progression rates and the yearly increment of 2880 new cases, 15 210 (95% CI 10 964–21 537) children with early-stage type 1 diabetes would be in paediatric care after 10 years of screening (figure A; appendix p 4). This number is expected to rise to 20 345 (14 321–29 345) after 20 years. These children would necessitate minimal follow-up paediatric care consisting of random plasma glucose, biannual HbA_{1c} measurements and less frequent oral glucose tolerance tests or continuous glucose monitoring[7] for an average duration of 6 years before progressing to clinical diabetes. In comparison, there are currently around 32 000 people younger than 18 years with type 1 diabetes diagnosed at a median age of 10 years,[6] requiring standard paediatric care for an average of 8 years before transitioning to adult care.

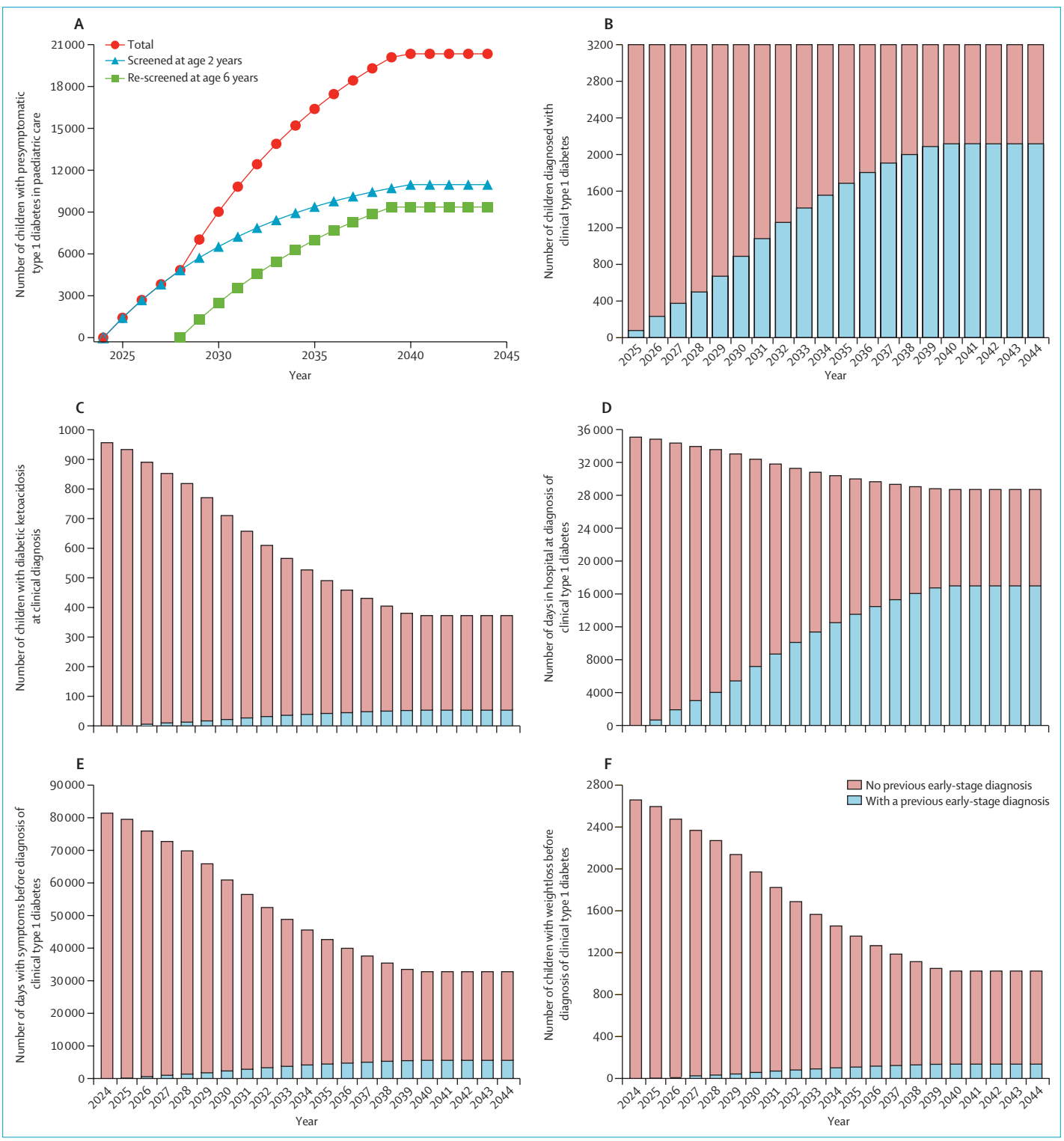
Although there will be additional costs, there will also be benefits associated with screening. Of the over 21 000 children with early-stage type 1 diabetes, an estimated 2124 would progress to clinical type 1 diabetes annually (figure B; appendix p 4). This corresponds to 66% of the 3200 yearly new cases. Considering the reported rate of diabetic ketoacidosis in children and adolescents aged younger than 18 years in Germany at around 30%[8] and the potential reduction of this rate to 2·5% through screening and follow-up care,[3] such a scenario could eventually reduce the number of cases of diabetic ketoacidosis at clinical diabetes onset by 61%, from 960 to 376 cases (figure C; appendix p 5). Moreover, on the basis of data from the Fr1da study,[9] hospitalisation time at diagnosis would be reduced by 18% from around 35 200 to 28 828 days (figure D; appendix p 5), the number of days with symptoms before diagnosis reduced by 60%, from 81 715 to 33 059 days (figure E; appendix p 5), and the number of children with weight loss before diagnosis by 71%, from to 2669 to 1035 children (figure F; appendix p 5).

The estimates in this study need to be interpreted after considering

***Figure*: Projected paediatric clinical care with population-wide screening for presymptomatic early-stage type 1 diabetes during childhood in Germany**

(A) Yearly estimated number of children with early-stage type 1 diabetes in early-stage paediatric care; numbers are based on introducing screening in children aged 2 years (open triangles) in 2025 and again when the children are aged 6 years (open squares) with 90% participation in screening; filled circles represent the total number of children in paediatric care for early-stage type 1 diabetes; the annual rate of progressing to clinical type 1 diabetes was estimated at 11% for children identified at age 2 years and 9% for children identified at 6 years. (B) Yearly estimates of the numbers of children who will develop clinical type 1 diabetes with (blue portion of the bar) and without (maroon portion of the bar) a previous diagnosis of early-stage type 1 diabetes. (C–F) Yearly estimates of the number of children with diabetic ketoacidosis at clinical diagnosis (C), total hospital days at clinical diagnosis (D), total days of symptoms before diagnosis (E), and the number of children with weight loss before clinical diagnosis (F) in children who will develop clinical type 1 diabetes with (blue portion of the bar) and without (maroon portion of the bar) a previous diagnosis of early-stage type 1 diabetes. Annual clinical diabetes rates, follow-up years, diabetic ketoacidosis frequency, hospitalisation, and the number of days of symptoms are based on previous studies.[1,3,8,9]

the following limitations. First, the calculations presented here do not account for the ongoing rise in the incidence of type 1 diabetes, currently projected at 2·5% annually. Consequently, the figures are probably conservative and might underestimate the actual effect. Second, the figures are contingent upon



90% participation in screening. Although typical participation rates in regular Well-child check-ups in Germany exceed 90%, achieving this degree of participation in screening is challenging and will require a concerted effort from health-care providers. A substantially lower participation will significantly reduce the numbers of children in clinical care for presymptomatic early-stage type 1 diabetes, but will also limit the benefits of screening (appendix p 6). Although options for improving the performance of screening strategies might exist, it is likely that efforts concentrated on fostering screening acceptance and implementation will yield the most effect and benefit. Third, the CIs around the estimates are wide. Fourth, the advent of therapies prolonging the presymptomatic phase of type 1 diabetes will influence estimates of future cases in paediatric care and shift cases from paediatric to adult care. Fifth, the calculations are confined to paediatric care and the influence on adult care of individuals with early-stage type 1 diabetes is unknown. Sixth, the estimates are based on models using data derived from Germany. Their applicability might vary for different regions within Germany and for countries with differing incidence rates of type 1 diabetes or paediatric health-care structures.

Despite their limitations, the estimates suggest that implementing a robust screening regimen coupled with follow-up of children with early-stage type 1 diabetes could eventually augment the overall count of children in paediatric care for type 1 diabetes by 60%. The proposed additional care will include counselling and monitoring for diabetes and might require intervention for anxiety in some families. These estimates offer a foundation for projecting the actual health-care costs associated with widespread childhood screening for type 1 diabetes. Cost estimates should also account for the significant decrease in cases presenting with diabetic ketoacidosis and symptoms, as well as the reduced hospitalisation days at diagnosis. Previous studies have suggested that mitigating diabetic ketoacidosis could lead to a less severe disease course following clinical diagnosis.[10] Further studies addressing the long-term effects of an early diagnosis and the effects of screening on children and families with an early-stage diagnosis of type 1 diabetes are required.

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Improving support for university students with type 1 diabetes

Using prevalence data from the UK,[1] we estimate that there are more than 10 000 university students with type 1 diabetes, out of a total student population of 2·8 million.

The individual burden of health care for university students with type 1 diabetes can be overwhelming. Diabetes self-management is challenging enough, but it is compounded by the need to adjust to an often stressful and erratic student life. There might be new challenges regarding day-to-day life including those related to cooking, relationships, and time schedules. Additional obstacles might include a reluctance to disclose a diagnosis of diabetes[2] or the exploration of risk-taking behaviour characteristic of young adulthood.[3]

Joining a new primary care practice (even when an on-campus surgery exists) can be challenging for students with type 1 diabetes. It can be especially difficult for those unfamiliar