

# BMJ Open Trends in type 2 diabetes incidence in a disadvantaged neighbourhood before and during implementation of complex community-based health interventions

Kasper Olesen , Maria Stougård , Pernille F Rønn , Paul Bloch

**To cite:** Olesen K, Stougård M, Rønn PF, *et al.* Trends in type 2 diabetes incidence in a disadvantaged neighbourhood before and during implementation of complex community-based health interventions. *BMJ Open* 2026;**16**:e111667. doi:10.1136/bmjopen-2025-111667

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<https://doi.org/10.1136/bmjopen-2025-111667>).

Received 29 September 2025  
Accepted 20 March 2026



© Author(s) (or their employer(s)) 2026. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ Group.

Steno Diabetes Center  
Copenhagen, Copenhagen  
University Hospital, Herlev,  
Capital Region of Denmark,  
Denmark

## Correspondence to

Dr Kasper Olesen;  
[kasper.olesen@regionh.dk](mailto:kasper.olesen@regionh.dk)

## ABSTRACT

**Objective** This study aims at exploring longitudinal trends in the onset of type 2 diabetes in the disadvantaged urban neighbourhood of Tingbjerg before and during implementation of interventions within the Danish health promotion initiative Tingbjerg Changing Diabetes. The findings are compared with trends in the national population.

**Design** Using Poisson regression, trends in age-specific incidence rates were estimated in both populations during the full timespan with adjustments for gender and educational attainment. We used anonymised national registers to obtain sociodemographic and health information about all residents in Tingbjerg. Likewise, information from the remaining national population was analysed for comparison.

**Setting** Tingbjerg is a disadvantaged neighbourhood with approximately 7000 residents located in the outskirts of Copenhagen.

**Participants** The full national adult population in Denmark, from 2003 to the end of 2022, was included in the study.

**Interventions** Tingbjerg Changing Diabetes is a long-term complex community-based health promotion initiative that started in 2015 and aims at enhancing well-being, promoting healthy living and preventing type 2 diabetes and other chronic diseases among residents of the local community.

**Outcomes** The outcome measure was onset of type 2 diabetes assessed by clinical register data.

**Results** Estimated trends show relatively higher age-adjusted incidence rates of type 2 diabetes in Tingbjerg compared with the national population with an almost two-fold higher rate in Tingbjerg in 2015. From 2015, a decline in the incidence rate was observed in Tingbjerg whereas an increase was observed in the national population, resulting in almost similar rates in 2022.

**Conclusions** Exploration of type 2 diabetes incidence rates from 2003 to 2022 shows relative improvements in Tingbjerg after 2015. It is unknown to what extent the interventions have impacted the observed trends.

## INTRODUCTION

Although their potentials are not fully realised, community-based interventions in urban settings are promising for health promotion

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study combines Danish national registers in a cohort with near-complete coverage of a full national population during an entire 20-year period.
- ⇒ Medically certified outcomes, free of bias related to self-reporting, are used to assess onset of type 2 diabetes among the residents.
- ⇒ Poisson regression adjusted for age, sex and educational attainment was used to model incidence trends with over-time comparability.
- ⇒ Relatively few residents in the neighbourhood of interest compared with the national population limited the statistical power.
- ⇒ The observational design did not allow for conclusions to be made about effects of the interventions despite use of longitudinal data.

and disease prevention.<sup>1</sup> Several studies have thus documented long-term health outcomes based on the implementation of complex community-based interventions.<sup>2–4</sup> In a review of 14 studies using multilevel and multicomponent interventions to obesity prevention, it was observed that the most promising behavioural and psychosocial outcomes were achieved when programmes were able to integrate intervention components at the policy, community and interpersonal levels.<sup>5</sup>

As health is strongly influenced by the social, cultural and environmental contexts of people's everyday lives,<sup>6,7</sup> neighbourhood characteristics play a significant role in shaping the risk behaviours of people<sup>8,9</sup> and influencing their long-term health conditions such as obesity and type 2 diabetes.<sup>10</sup> Several studies have shown that residents of socially disadvantaged neighbourhoods have higher rates of mortality and morbidity than residents of more affluent neighbourhoods.<sup>11–13</sup> In addition, studies have shown that individuals exposed to neighbourhood socioeconomic disadvantage cumulated



across the life course are at increased risk of developing diabetes.<sup>14</sup>

Evaluating multilevel and multicomponent interventions is challenged by difficulties to attribute specific outcomes to specific actions. It may thus not be feasible to evaluate the impact of individual intervention components in isolation, but rather to explore the combined impact, if any, of the full initiative. However, using theory-based realistic evaluation methodology<sup>15</sup> may strengthen the understanding of how and under what circumstances interventions bring about change.<sup>16</sup> This is particularly important in long-term community-driven initiatives where interventions may be diverse, overlapping and frequently replacing each other in dynamic processes responding to ever-changing development needs. In such circumstances, and as an alternative to searching for specific causative factors, observed changes may inherently be attributed to multiple and mutually dependent actions that are essential in their entirety to induce change.

Tingbjerg Changing Diabetes was launched in 2015 as a long-term community-based initiative to enhance well-being, promote healthy living and prevent chronic diseases, including type 2 diabetes, among high-risk population groups living in the neighbourhood of Tingbjerg in the capital region of Denmark.<sup>17</sup> Tingbjerg is situated about eight kilometres north of Copenhagen city centre and is one of Denmark's largest social housing areas with almost 7000 residents.

It is characterised by high ethnic diversity and numerous nationalities contributing to a wealth of cultures, languages and traditions. It is also considered a socially vulnerable community due to poor socioeconomic indicators. Prevalence rates of chronic diseases, including diabetes, are high compared with other parts of Copenhagen.<sup>18</sup>

Tingbjerg Changing Diabetes applies the Supersetting approach to attain synergistic effects of comprehensive interventions through coordinated engagement of multiple stakeholders in multiple settings, while mobilising local resources and strengthening social networks for collective community action.<sup>19</sup> The Supersetting approach adheres to five core principles: (1) *integration*, to ensure that activities are implemented through coordinated actions across the boundaries of specific settings, (2) *participation*, to ensure that people are motivated to take ownership of processes of developing and implementing activities, (3) *empowerment*, to ensure that people acquire skills and competencies to express and act on their needs and aspirations, (4) *context sensitivity*, to ensure that everyday life challenges of citizens and professionals are respected and considered when developing and implementing activities, and (5) *knowledge generation and sharing*, to ensure that scientific knowledge is produced *from* action and used to *inform* action.

## Aim

The present study analyses demographic, socioeconomic and health data to document if any changes have occurred in the incidence of type 2 diabetes in Tingbjerg over two decades from 2003 to 2022. The study had no prespecified hypotheses, but particular attention was paid to incidence trends in the years following 2015 when health promotion and disease prevention efforts were substantially intensified through Tingbjerg Changing Diabetes. The findings are compared with incidence data for Denmark as a whole.

## METHODS

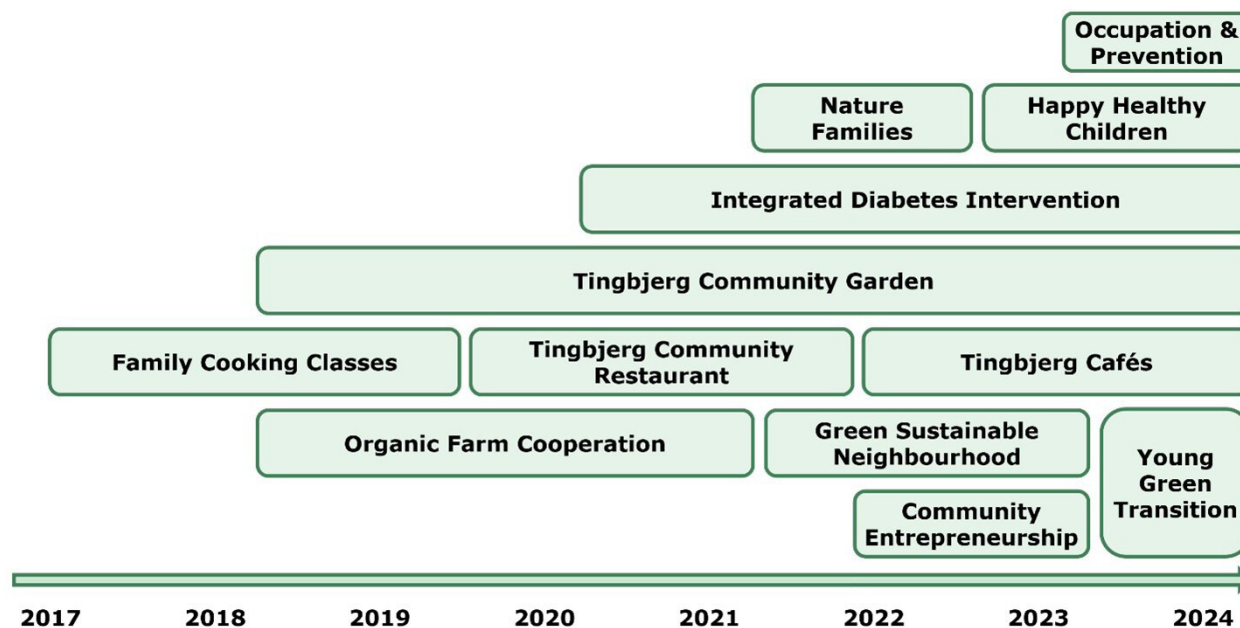
### Neighbourhood interventions

Since 2015, a variety of social and health promotion interventions have been implemented jointly by multiple partners within the framework of Tingbjerg Changing Diabetes.<sup>17</sup> In the period from 2015 to 2016 the initiative was established, a health promotion network of professional stakeholders was revitalised, the first partnership was formalised and numerous qualitative interviews and focus group discussions were conducted with residents to understand their challenges, needs and demands. In the first part of 2017, a household-based survey on residents' well-being was conducted in the neighbourhood. This involved 200 households equivalent to 8% of all households in the neighbourhood. From 2017 to 2024, one major intervention project after the other was initiated and implemented in the neighbourhood (figure 1). Until the initiation of the disease-specific project Integrated Diabetes Intervention in Tingbjerg in 2020, all these projects addressed social development and health promotion emphasising community engagement and healthy living for target groups across the life course.

### Data sources and variables

The study population was identified from the Danish Civil Registration System and consisted of all adults residing in Denmark from 2003 to 2022 (n=93 765 408 person years; 6 204 351 unique individuals). Residency was recorded annually on the first of January and was defined as either residing in the neighbourhood of Tingbjerg (identical to the Tingbjerg Parish) or in the Danish background population. All adults residing in Denmark on any 1 January during the study period were included, contributing with data for up to 20 years. The study period was restricted to the calendar years from 2003 to 2022 to safeguard the availability of reliable data at the time of analysis. Moreover, housing stock in Tingbjerg remained relatively stable during this period largely without constructions of new apartment buildings.

All data for the analyses were derived from national registers administered by Statistics Denmark. Data on migration, demography and socioeconomic position were derived annually from linkage to Statistics Denmark.<sup>20 21</sup> Onset of diabetes was identified using a diabetes register.<sup>22</sup> This is a meta-register that combines information from



**Figure 1** Major health promotion interventions of the Tingbjerg Changing Diabetes initiative.

five Danish health service registries, most notably the National Patient Register, which contains diagnoses from all in-patients and out-patient hospitalisations in Danish hospitals.<sup>23</sup> All variables were integrated into the same dataset.

We used educational attainment as a measure of socioeconomic position. Education was categorised into three levels based on the International Standard Classification of Education: (1) primary and lower-secondary education, (2) upper-secondary education and (3) tertiary education. The educational data were derived from the Danish Educational Register.<sup>24</sup> This includes only education completed at Danish institutions, which may result in underestimation of the educational attainment of some individuals, particularly migrants.

Immigration status was categorised into three groups: Danes, immigrants or descendants of immigrants. This variable is based on the official classifications used by Statistics Denmark. Immigrants were defined as individuals born outside Denmark whose parents were neither born in Denmark nor were Danish citizens; their country of origin was defined as their country of birth. Descendants were defined as persons born in Denmark whose parents are either immigrants or descendants with foreign citizenship. The remaining population was defined as Danes.

Occupation data were categorised into three groups based on individuals' main activity during the previous year: (1) working residents, (2) residents studying or receiving age-related retirement benefits and (3) 'not working' referring to people not included in the first two categories. The 'not working' category is broader than official definitions of unemployment and includes individuals who are not actively seeking employment.

Onset of type 2 diabetes was assigned to the calendar year in which it was recorded in the register. Incident

diabetes during a calendar year was then linked to the persons' residency 1 January each year. Socioeconomic information was available annually and was derived from November in the previous year.

### Statistical analyses

Descriptive statistics were used to characterise the populations in 2003 (first observation year), 2022 (last observation year) and 2015 (last observation before Tingbjerg Changing Diabetes was launched). We used Poisson regression with log-person years as offset to estimate trends in incidence rates of type 2 diabetes in Tingbjerg and in the background Danish population. The populations were followed from 1 January 2003, until diabetes diagnosis, death, emigration out of Denmark or 31 December 2022, whichever occurred first. Models were adjusted for educational attainment, gender and age (with both a linear and quadratic term, as the model fit indices improved substantially with both terms included) and incidence rates were calculated separately for the two populations.

Incidence rates were visualised in figures with age and calendar time as explanatory factors for change in incidence for both Tingbjerg and the national population. Rates were calculated for both men and women. To test the impact of migration in and out of Tingbjerg, sensitivity analyses were carried out exclusively including individuals who had lived in either Tingbjerg or Denmark, respectively, for at least 2 years prior to the observation point. Moreover, a sensitivity analysis adjusted for occupational status rather than educational attainment was carried out.

In all analyses, participants were included only during periods where they were considered at risk of developing type 2 diabetes, that is, when they were alive, residing in Denmark and had no prior diagnosis of type 1 or type

**Table 1** Characteristics of the study populations on 1 January in 2003, 2015 and 2022

|                 |                    | Tingbjerg   |             |             | Denmark     |             |             |
|-----------------|--------------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                 |                    | 2003        | 2015        | 2022        | 2003        | 2015        | 2022        |
| Population      | N                  | 4425        | 5019        | 4628        | 4 189 498   | 4 555 051   | 4 785 345   |
| Age             | Median (Q1, Q3)    | 38 (28, 53) | 37 (27, 51) | 40 (27, 55) | 45 (32, 59) | 48 (33, 63) | 49 (32, 64) |
| Gender          | % female           | 51.6        | 48.4        | 50.7        | 51.1        | 50.7        | 50.6        |
| Education       | Low                | 56.1        | 46.3        | 40.0        | 35.5        | 30.4        | 25.2        |
|                 | Intermediate       | 32.9        | 29.9        | 34.8        | 40.7        | 41.1        | 40.7        |
|                 | High               | 11.1        | 23.8        | 25.2        | 23.8        | 28.5        | 34.1        |
| Occupation      | Not working        | 41.8        | 35.4        | 26.4        | 16.2        | 14.5        | 14.1        |
|                 | Working            | 35.5        | 40.8        | 46.5        | 57.1        | 53.0        | 55.7        |
|                 | Student/retirement | 22.8        | 23.8        | 27.1        | 26.8        | 32.6        | 30.2        |
| Ethnicity       | Dane               | 48.4        | 22.1        | 22.9        | 92.5        | 88.4        | 85.5        |
|                 | Migrant            | 48.5        | 67.1        | 59.4        | 7.0         | 10.3        | 12.5        |
|                 | Migrant heritage   | 3.1         | 10.8        | 17.7        | 0.5         | 1.4         | 2.1         |
| Type 2 diabetes | Prevalence %       | 5.1         | 8.6         | 10.9        | 3.3         | 6.1         | 7.2         |

2 diabetes. Individuals not at risk at certain time points were censored during these time periods.

## RESULTS

A total of 6 204 351 unique persons were included in the study population, representing a total of 93 765 408 person years during the observation period spanning from 1 January 2003 to 31 December 2022. Approximately 0.1% of the study population had residency in Tingbjerg, among whom less than 50 people had onset of type 2 diabetes each year during the observation period.

Table 1 shows the characteristics of the study population at the beginning of the observation period in 2003, at the end in 2022, and in 2015 before the Tingbjerg Changing Diabetes initiative was initiated. The population is stratified by residence such that ‘Tingbjerg’ constitutes 0.1% of the adult population with residence in Tingbjerg, whereas ‘Denmark’ constitutes the remaining 99.9% of the adult Danish population.

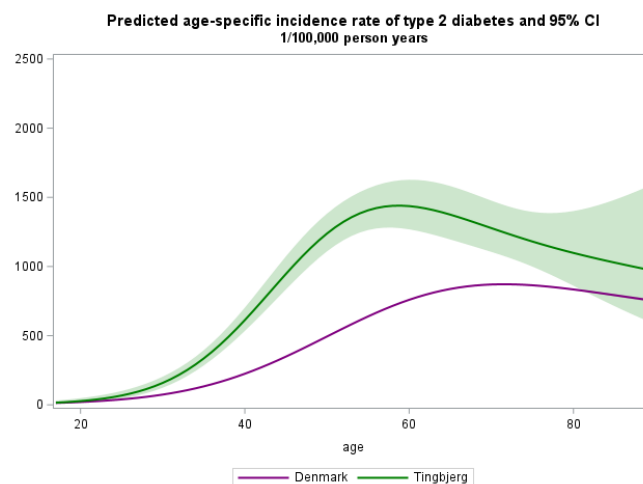
Adult residents in Tingbjerg were relatively young across all calendar years with median age around 40 compared with almost 50 in the national population. From 2003 to 2022, there was an increase in type 2 diabetes in Tingbjerg as well as in the rest of Denmark with highest prevalence observed in Tingbjerg.

Educational attainment was low in Tingbjerg throughout the period with 56% having low education in 2002, but in both Tingbjerg and Denmark a substantial increase was observed from 2008 to 2022. Rates of unoccupied residents were high in Tingbjerg but declined from 2015 to 2022 to become closer to the relatively stable Danish figures.

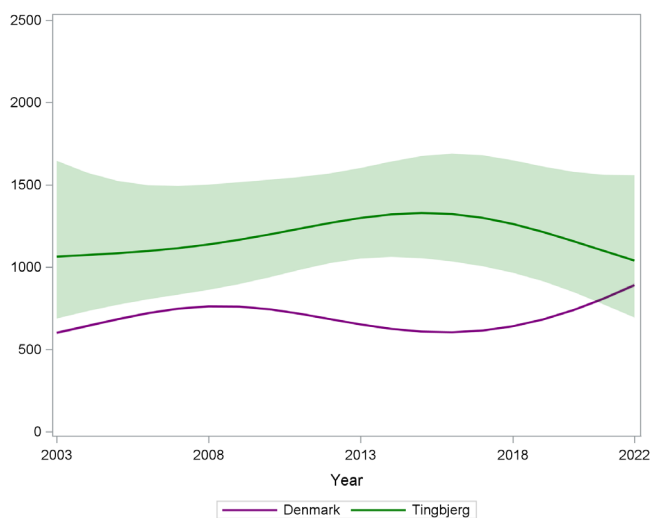
In 2003, almost 50% of all residents in Tingbjerg were ethnic Danes and slightly more than 50% were migrants or descendants of migrants. In 2015 and 2022, the proportion of ethnic Danes was slightly more than 20% and almost 80% were migrants or descendants.

Figure 2 shows estimated trends in age-specific incidence of type 2 diabetes in Tingbjerg and Denmark throughout the observation period. In both populations, the rates increased up to approximately 60 and 70 years, respectively, followed by a flat or declining trend. The incidence rate was higher in Tingbjerg across all age groups and peaked at around 1500 (per 100 000 person years) compared with approximately 1000 (per 100 000 person years) in Denmark. Moreover, the incidence rate had a steeper increase in Tingbjerg than the background population. The relatively low number of annual cases recorded in Tingbjerg results in wide CIs, whereas the CIs for Denmark are small.

Figures 3 and 4 show estimated trends in diabetes incidence in Tingbjerg and Denmark from 2003 to 2022 for women (figure 3) and men (figure 4), depicted with values for a 65-year-old person with upper-secondary education. The estimated CI is indicated by a speckled

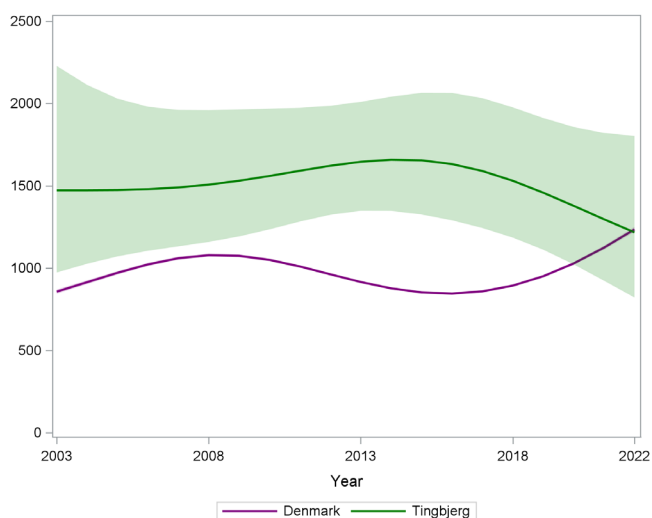


**Figure 2** Predicted age-specific incidence rate of type 2 diabetes and 95% CI (1/100 000 person years).



**Figure 3** Predicted annual incidence rate of type 2 diabetes in women and 95% CI (1/100 000 person years).

area, which due to high statistical power is barely visible for the estimated incidence in the national population. In both populations, estimated incidence rates were smaller for women than men. For both women and men, the incidence rates varied by period and residency. In the national population, there was an overall increase throughout the full period even though rates temporarily dropped from approximately 2008 to 2015. In Tingbjerg, an increasing trend was observed from 2003 until approximately 2015, followed by a decreasing trend until the end of the observation period in 2022. From 2015 to 2022, the annual incidence rate of type 2 diabetes in Tingbjerg thus steadily approached the incidence rate in the background national population. Although a simple extrapolation of current findings will result in converged trend lines for Tingbjerg and Denmark, the statistical model does not permit assumptions about trends outside the observation period.



**Figure 4** Predicted annual incidence rate of type 2 diabetes in men and 95% CI (1/100 000 person years).

In a sensitivity analysis, the modelled trends were restricted to observations from people who had not moved away from Tingbjerg or Denmark, respectively, during the previous two calendar years. In another sensitivity analysis, models were adjusted for occupational status rather than education. The trends from both sensitivity analyses were in line with the trends shown in figures 3 and 4 (see online supplemental material).

## DISCUSSION

This study explored the trends in the incidence rate of type 2 diabetes for the disadvantaged neighbourhood of Tingbjerg, Copenhagen, during a span of 20 years. We compared the data with the nationwide incidence rate of type 2 diabetes in Denmark and found a significantly higher incidence rate in Tingbjerg during the entire period, except for 2022 where the rates approached each other. The estimated incidence rate in Tingbjerg increased prior to 2015 and then declined until the end of the observation period in 2022. Contrary, during the period from 2015 to 2022, the incidence rate in Denmark increased.

Multiple health promotion interventions were implemented and coordinated by Tingbjerg Changing Diabetes during this period, and it is therefore reasonable to suggest that the interventions may have contributed positively to the estimated incidence trend in the neighbourhood.

The incidence analyses were adjusted for age, gender and educational attainment and those factors are unlikely to explain the observed trends. Interestingly, the increasing incidence rate of type 2 diabetes in Tingbjerg from 2003 to 2015 coincided with an increase in proportion of immigrant residents or descendants thereof in the neighbourhood. However, from 2015 to 2022 the number of immigrants and descendants thereof stagnated while the incidence of type 2 diabetes declined in Tingbjerg and increased in Denmark at large. Most of the immigrants originate from countries in the Middle East, North Africa and South-East Asia, whereas a larger proportion of migrants in Denmark at large originates from other European countries.

Previous studies have documented significant reductions in the incidence of type 2 diabetes among people enrolled in specific diabetes prevention programmes targeting lifestyle change, education and/or counselling.<sup>25–28</sup> These interventions have been implemented in accordance with specific lifestyle prescriptions in supervised environments. In a systematic review of the effectiveness of community-based health promotion interventions in urban areas around the world, various behavioural changes were observed but only limited changes in primary health outcomes.<sup>1</sup> The review concluded that community-based interventions are promising for health promotion and disease prevention, although their potentials had not been fully realised. To our knowledge, the present study is the first to document reductions in the



primary health outcome of type 2 diabetes incidence rates at population level in non-prescriptive community-based health promotion interventions. Tingbjerg Changing Diabetes is thus a long-term natural experiment in community development with a strong emphasis on promoting social transition and healthy living. Interventions are defined and implemented jointly by citizens and frontline practitioners operating in Tingbjerg across a wide spectrum of professions, sectors and settings. Numerous national stakeholder organisations from the public sector, the private sector, civil society and academia provide technical, educational and financial support to the local initiatives. In this way, a resilient partnership-based system of support has been established, and operations have been sustained over long periods of time.

This study has strengthened our conviction that complex health challenges must be addressed by complex interventions and that impactful single change agents and actions are illusory. We therefore advocate for studying change potentials at population level based on wider community mobilisation and development efforts.

Despite inclusion of data from a full national population, the population in Tingbjerg constituted only 0.1% of our data resulting in limited statistical power. Therefore, the study was restricted exclusively to investigate long-term trends for the full population and was not powered to explore incidence trends in further details. Neither could we explore impact of potential mediators between the intervention and subsequent incidence rates. Moreover, a large CI for the Tingbjerg trend estimate makes the true direction of the trend lines uncertain and they cannot be extrapolated beyond the observation period. The relatively short follow-up time from initiation of Tingbjerg Changing Diabetes until the end of follow-up is a limitation, given that type 2 diabetes may develop slowly in many people, and potential benefits of the intervention may not unfold during the follow-up period. A future study with longer follow-up time will offer potential to provide further insights and strengthen the conclusions.

A main strength of the study is the use of nationwide register data free of bias associated with non-responses. Other studies based on self-reports are characterised by lower response rates particularly among ethnic minorities and vulnerable residents.<sup>29</sup>

## CONCLUSION

We estimated an increasing trend in the incidence rate of type 2 diabetes in Tingbjerg in both men and women in the period from 2003 to 2015. This was followed by a slightly decreasing trend until the end of follow-up in 2022 corresponding to the timing of intensified health promotion interventions implemented through Tingbjerg Changing Diabetes. The latter decrease coincided with an increase in incidence rate of type 2 diabetes in the national Danish background population. Even though we cannot attribute observed trends in the incidence rate to any specific causes, we find it possible that the

interventions impacted positively on the health status and trends in the incidence of type 2 diabetes in the neighbourhood. The present study therefore concludes that complex long-term community-based interventions in disadvantaged neighbourhoods may have the potential to facilitate positive health outcomes including reductions in onset of type 2 diabetes.

**Contributors** The study was conceived by KO (guarantor) and PB. It was planned by KO, MS, PFR and PB. The data analysis was performed by KO. The manuscript was drafted by KO, with revisions and final approval from MS, PFR and PB.

**Funding** The Tingbjerg Changing Diabetes (TCD) initiative received financial support from the Novo Nordisk Foundation (grant number: NNF180C0052046).

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

**Patient consent for publication** The study was exclusively based on anonymised data hosted by Statistics Denmark following regulations to ensure no identification of individuals. Individual consent was neither required nor possible due to the anonymisation of the data.

**Ethics approval** The study was approved by and complies with the personal data protection policy of the Capital Region of Denmark (P-2019-511).

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data may be obtained from a third party and are not publicly available. Data used for this study are owned and managed by Statistics Denmark.

**Supplemental material** This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

Kasper Olesen <https://orcid.org/0000-0002-3638-4005>

Maria Stougård <https://orcid.org/0000-0002-5573-4971>

Pernille F Rønn <https://orcid.org/0000-0001-6338-6615>

## REFERENCES

- Nickel S, von dem Knesebeck O. Effectiveness of Community-Based Health Promotion Interventions in Urban Areas: A Systematic Review. *J Community Health* 2020;45:419–34.
- Economos CD, Hyatt RR, Must A, *et al*. Shape Up Somerville two-year results: a community-based environmental change intervention sustains weight reduction in children. *Prev Med* 2013;57:322–7.
- Simon C, Kellou N, Dugas J, *et al*. A socio-ecological approach promoting physical activity and limiting sedentary behavior in adolescence showed weight benefits maintained 2.5 years after intervention cessation. *Int J Obes (Lond)* 2014;38:936–43.
- Recasens MA, Xicola-Coromina E, Manresa J-M, *et al*. Impact of school-based nutrition and physical activity intervention on body mass index eight years after cessation of randomized controlled trial (AVall study). *Clin Nutr* 2019;38:2592–8.
- Ewart-Pierce E, Mejía Ruiz MJ, Gittelsohn J. “Whole-of-Community” Obesity Prevention: A Review of Challenges and Opportunities in Multilevel, Multicomponent Interventions. *Curr Obes Rep* 2016;5:361–74.

- 6 Closing the gap in a generation: health equity through action on the social determinants of health. In: *Final report of the commission on social determinants of health*. Geneva: World Health Organization, 2008.
- 7 Frohlich KL, Abel T. Environmental justice and health practices: understanding how health inequities arise at the local level. *Sociol Health Illn* 2014;36:199–212.
- 8 Algren MH, Bak CK, Berg-Beckhoff G, *et al*. Health-Risk Behaviour in Deprived Neighbourhoods Compared with Non-Deprived Neighbourhoods: A Systematic Literature Review of Quantitative Observational Studies. *PLoS One* 2015;10:e0139297.
- 9 Algren MH, Ekholm O, van Lenthe F, *et al*. Health-risk behaviour among residents in deprived neighbourhoods compared with those of the general population in Denmark: A cross-sectional study. *Health Place* 2017;45:189–98.
- 10 Ludwig J, Sanbonmatsu L, Gennetian L, *et al*. Neighborhoods, obesity, and diabetes--a randomized social experiment. *N Engl J Med* 2011;365:1509–19.
- 11 Kawachi I, Berkman LF. *Neighborhoods and health*. Oxford: Oxford University Press, 2003.
- 12 Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *J Epidemiol Community Health* 2001;55:111–22.
- 13 Poortinga W, Dunstan FD, Fone DL. Neighbourhood deprivation and self-rated health: the role of perceptions of the neighbourhood and of housing problems. *Health Place* 2008;14:562–75.
- 14 Kivimäki M, Vahtera J, Tabák AG, *et al*. Neighbourhood socioeconomic disadvantage, risk factors, and diabetes from childhood to middle age in the Young Finns Study: a cohort study. *Lancet Public Health* 2018;3:e365–73.
- 15 Pawson R, Tilley N. *Realistic evaluation*. London: SAGE, 1997.
- 16 Skivington K, Matthews L, Simpson SA, *et al*. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ* 2021;374:n2061.
- 17 Tørslev MK, Andersen PT, Nielsen AV, *et al*. Tingbjerg Changing Diabetes: a protocol for a long-term Supersetting initiative to promote health and prevent type 2 diabetes among people living in an ethnically and socioeconomically diverse neighbourhood in Copenhagen, Denmark. *BMJ Open* 2021;11:e048846.
- 18 The Danish Diabetes Association. Diabetestalnu. Available: <https://www.diabetestalnu/> [Accessed 1 May 2025].
- 19 Bloch P, Toft U, Reinbach HC, *et al*. Revitalizing the setting approach - supersettings for sustainable impact in community health promotion. *Int J Behav Nutr Phys Act* 2014;11:118.
- 20 Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39:22–5.
- 21 Schmidt M, Schmidt SAJ, Sandegaard JL, *et al*. The Danish National Patient Registry: a review of content, data quality, and research potential. *Clin Epidemiol* 2015;7:449–90.
- 22 Carstensen B, Rønn PF, Jørgensen ME. Prevalence, incidence and mortality of type 1 and type 2 diabetes in Denmark 1996–2016. *BMJ Open Diabetes Res Care* 2020;8:e001071.
- 23 Lyngø E, Sandegaard JL, Rebolj M. The Danish National Patient Register. *Scand J Public Health* 2011;39:30–3.
- 24 Jensen VM, Rasmussen AW. Danish Education Registers. *Scand J Public Health* 2011;39:91–4.
- 25 Shirinzadeh M, Afshin-Pour B, Angeles R, *et al*. The effect of community-based programs on diabetes prevention in low- and middle-income countries: a systematic review and meta-analysis. *Global Health* 2019;15:10.
- 26 Andreae SJ, Reeves H, Casey T, *et al*. A systematic review of diabetes prevention programs adapted to include family members. *Prev Med Rep* 2024;39:102655.
- 27 Lindström J, Peltonen M, Eriksson JG, *et al*. Improved lifestyle and decreased diabetes risk over 13 years: long-term follow-up of the randomised Finnish Diabetes Prevention Study (DPS). *Diabetologia* 2013;56:284–93.
- 28 Shirvani T, Javadivala Z, Azimi S, *et al*. Community-based educational interventions for prevention of type II diabetes: a global systematic review and meta-analysis. *Syst Rev* 2021;10:81.
- 29 Schneider KL, Clark MA, Rakowski W, *et al*. Evaluating the impact of non-response bias in the Behavioral Risk Factor Surveillance System (BRFSS). *J Epidemiol Community Health* 2012;66:290–5.