

# All-cause and suicide mortalities among adolescents and young adults who contacted specialised gender identity services in Finland in 1996–2019: a register study

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## ABSTRACT

**Background** All-cause and suicide mortalities of gender-referred adolescents compared with matched controls have not been studied, and particularly the role of psychiatric morbidity in mortality is unknown.

**Objective** To examine all-cause and suicide mortalities in gender-referred adolescents and the impact of psychiatric morbidity on mortality.

**Methods** Finnish nationwide cohort of all <23 year-old gender-referred adolescents in 1996–2019 (n=2083) and 16 643 matched controls. Cox regression models with HRs and 95% CIs were used to analyse all-cause and suicide mortalities.

**Findings** Of the 55 deaths in the study population, 20 (36%) were suicides. In bivariate analyses, all-cause mortality did not statistically significantly differ between gender-referred adolescents and controls (0.5% vs 0.3%); however, the proportion of suicides was higher in the gender-referred group (0.3% vs 0.1%). The all-cause mortality rate among gender-referred adolescents (controls) was 0.81 per 1000 person-years (0.40 per 1000 person-years), and the suicide mortality rate was 0.51 per 1000 person-years (0.12 per 1000 person-years). However, when specialist-level psychiatric treatment was controlled for, neither all-cause nor suicide mortality differed between the two groups: HR for all-cause mortality among gender-referred adolescents was 1.0 (95% CI 0.5 to 2.0) and for suicide mortality was 1.8 (95% CI 0.6 to 4.8).

**Conclusions** Clinical gender dysphoria does not appear to be predictive of all-cause nor suicide mortality when psychiatric treatment history is accounted for.

**Clinical implications** It is of utmost importance to identify and appropriately treat mental disorders in adolescents experiencing gender dysphoria to prevent suicide.

## BACKGROUND

Gender dysphoria (GD) refers to the distress or impairment in functioning that a person may experience when their gender identity does not align with their biological sex. GD is often accompanied by a desire to obtain hormonal and surgical treatment (medical gender reassignment (GR)) to align the body with the experienced gender.<sup>1</sup> The number

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ No previous study has examined all-cause and suicide mortalities of gender-referred adolescents compared with matched controls nor while controlling for psychiatric morbidity.
- ⇒ The effects of medical gender reassignment on suicide risk in this population are not known.

## WHAT THIS STUDY ADDS

- ⇒ Gender dysphoria per se does not seem to predict neither all-cause nor suicide mortality in gender-referred adolescents.
- ⇒ Main predictor of mortality in this population is psychiatric morbidity, and medical gender reassignment does not have an impact on suicide risk.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ It is of utmost importance to identify and appropriately treat mental disorders in adolescents experiencing gender dysphoria to prevent suicide; in addition, health policies need to ensure that accurate information is provided to professionals along these lines.

of adolescents referred to specialised gender identity services (gender-referred adolescents) to consider GR has increased significantly in the 21st century.<sup>2–3</sup> Psychiatric morbidity is common in gender-referred adolescents.<sup>4</sup> GR may be initiated during the developmental years with expectations of better bodily outcomes than when treatments are initiated in adulthood, and with positive psychosocial outcomes such as reduced depression, self-harm and suicidality<sup>5–6</sup>; however, the evidence base for these psychosocial benefits is weak.<sup>7–8</sup>

Studies have reported increased mortality rates in adults diagnosed with GD, with rates of up to two to three times those of the general population, both in patients who proceeded to GR<sup>9–12</sup> and those whose treatment status was not disclosed.<sup>13–14</sup> This elevated mortality in this population has been associated with ischaemic heart disease, cancer and external causes, such as substance abuse and



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suicide, and in some countries, HIV infection.<sup>10 12</sup> However, the all-cause mortality of young people seeking care for gender identity-related issues has not been studied. Moreover, to our knowledge, no previous study has examined the possible differences in mortality by directly comparing those who proceeded to GR to those who did not.

Among gender-referred adolescents, self-harming thoughts, self-injurious behaviours and suicide attempts are common, with a prevalence of up to 50% of the patients.<sup>15–17</sup> However, only a few studies have reported confirmed suicide deaths among transgender-identifying or gender-referred adolescents. Biggs<sup>18</sup> reported four suicides among young people who sought treatment at a British gender identity clinic between 2007 and 2020 (n=15 032, followed up to 30 080 patient-years) during a follow-up period of approximately 3 years. This corresponded to 0.03% of all clinical youth (0.13 suicides/1000 patient-years), and the suicide risk was estimated to be 5.5 times higher compared with a same-age general population sample.<sup>18</sup> In a Belgian gender identity clinic study conducted with 177 young people who sought treatment between 2007 and 2016, five (2.8%) of them died by suicide, which corresponded to a mortality rate of 9.42/1000<sup>18 19</sup> during their adolescent years. Neither of these studies accounted for GR. In a recent US study, two out of 337 participants (0.6%) who started hormone therapy committed suicide within a year of treatment initiation, corresponding to a suicide rate of 5.9/1000 person-years.<sup>20</sup> None of these studies assessed the significance of psychiatric morbidities for suicide mortality nor compared those who proceeded to GR and those who did not. In long-term follow-up studies on the suicide mortality of adults diagnosed with GD, suicide mortality ranging from 0.3% to 3% and rates of 0.7–2.7/1000 person-years have been reported, and these figures are 3.5–19 times higher than those for the general population.<sup>9–13 21</sup> Only one study attempted to consider the role of psychiatric morbidity in suicide risk, and in it, the suicide rate among transgender adults who underwent GR surgery was approximately three times higher than that of matched controls after accounting for psychiatric morbidity.<sup>11</sup> Despite the lack of studies on psychiatric morbidity in the context of GD, it remains that psychiatric morbidity is a well-established predictor of suicide,<sup>22</sup> a major confounding factor, and 20–80% of young people seeking gender identity services present with psychiatric morbidities.<sup>4</sup>

## Objective

In summary, the all-cause mortality of gender-referred adolescents compared with matched controls has not been studied, and the role of GR in all-cause mortality is unknown. Furthermore, suicide mortality among adolescents with clinically significant GD has rarely been studied. Methods enabling direct comparison with a same-age population have not been used, the role of psychiatric morbidity has not been considered and the impact of GR treatments on suicide mortality is unknown. This study aimed to address these gaps in the literature and investigate the mortality of gender-referred adolescents compared with matched controls using comprehensive Finnish registry data. The research questions are as follows:

1. Do the all-cause and suicide mortalities of gender-referred adolescents differ from those of matched control populations?
2. Are any observed differences in mortality between gender-referred adolescents and matched controls explained by psychiatric morbidity?
3. What is the impact of GR on mortality among gender-referred adolescents?

## METHODS

### Finnish registers

Each Finnish citizen is assigned an 11-digit personal identification number at birth or on acquiring citizenship status. This number serves as a unique identifier for individuals in various government registers, such as healthcare units. This identifier allows for the linkage of individual-level data across different registers. The Finnish Population Information System is a nationwide central registry that contains up-to-date personal information of all Finnish citizens. The National Institute for Health and Welfare has registered data on all Finnish citizen healthcare visits, including the location of the event, primary and secondary diagnoses, procedure codes and specialty codes, in its Care Register for Health Care (CRHC) since 1994. The Social Insurance Institution of Finland (Kela) registers the purchase of prescription medications. The cause of death register records information on citizens' causes and times of death. Moreover, these register datasets can be used for scientific research according to the Regulation (European Union) 2016/679 of the European Parliament and Council,<sup>23</sup> based on appropriate permission from the Social and Health Data Permit Authority Findata and Statistics Finland. Using register data enables the compilation of comprehensive and reliable data without loss to follow-up.

### Study population

In Finland, the gender identity assessment that may result in GR is nationally centralised to two university hospitals (Tampere and Helsinki University Hospitals). This study comprised a register-based follow-up of individuals who entered nationally centralised gender identity clinics in Finland from 1996 to 2019 before turning 23 years. The follow-up for each participant (later also a gender-referred individual) began when they entered the gender identity teams, that is, during their first appointment at the gender identity services and according to the subsequent provision of the following diagnoses: F64.0, F64.2, F64.8 or F64.9 (the index date). The follow-up period was extended until death or until June 2022, when the dataset was compiled. We did not restrict the upper age limit of the study sample to 18 years, as is common in many previous adolescent studies, because the identity development of young people continues beyond reaching legal adulthood.<sup>24</sup>

### Control group

Four male and four female controls matched for age and municipality of birth were extracted from the Population Information System for each gender-referred individual. The gender-referred individual's index date was assigned to all controls.

### Outcome measures

Information on the date and cause of death was obtained from the cause of death register, which relies on data from the Digital and Population Data Services Agency. This agency maintains records of all deaths in Finland along with their causes, as reported on death certificates.

### Variables

The number of contacts with specialist-level psychiatric care was extracted from the CRHC. The number of contacts, excluding the specialised gender identity assessment, was used in the analyses and classified as follows: none, 1–5, 6–25, 26–100 and 101+.

GR includes masculinising/feminising hormonal treatments, mastectomies and/or genital surgery. Transgender persons

diagnosed with F64.0 in the nationally centralised services (since 2023, F64.8) can obtain the right to special reimbursement from the national social insurance for their hormonal GR. This can occur when treatment is continued for a year, and means that special reimbursement for cross-sex hormone therapy can be used as an indicator of hormonal GR. This information was obtained from the Social Insurance Institution of Finland (Kela). Information on surgical GR was obtained from the CRHC.

Birth year and currently registered sex data were extracted from the Population Information System. The register does not allow researchers to track changes in the registered sex.

### Statistical analyses

The data were pseudonymised by Statistics Finland and analysed using IBM SPSS Statistics V.27.0. Basic demographic information was assessed using cross-tabulation and  $\chi^2$  tests (Fisher's exact test where appropriate). Cox regression models were used to analyse mortality rates. HRs with 95% CIs were calculated for all-cause and suicide mortalities. The dependent variables (all-cause mortality and suicide mortality) were used. Group membership (gender referred, controls) was entered as the independent variable, first controlling for registered sex and birth year, and subsequently adding the number of specialist-level psychiatric treatment contacts. Multivariate models were finally rerun, further categorising the gender-referred group into those who had (GR+) and had not proceeded to (GR-) GR. In order to avoid type 1 error due to multiple testing and the large data size, the cut-off for statistical significance was set at a  $p < 0.01$ .

### Patient and public involvement

Patients or members of the public did not have direct participation in the design, execution or reporting of this research.

### FINDINGS

There were 2083 individuals under the age of 23 years who sought gender identity assessments, and 16 643 matched controls. The mean age of gender-referred individuals at the time of seeking gender identity assessments was 18.5 (SD 2.2), with a median age of 19 (8–22) years. The mean follow-up time was 6.53 years, with a median of 5.74 (2.41–25.69) years. Gender-referred individuals contributed 13 602 person-years of follow-up, whereas the controls contributed 108 756 person-years.

The demographic characteristics of the study population are summarised in [table 1](#). Among gender-referred individuals,

41.3% were registered males ( $p < 0.001$ ). There were 55 deaths in the study population, including 20 suicides. In bivariate analyses, all-cause mortality did not statistically significantly differ between gender-referred individuals and controls; however, the proportion of suicides was higher in the gender-referred group (0.3% vs 0.1%;  $p = 0.004$ ). Psychiatric treatment was more common and the number of contacts was higher among gender-referred individuals than among the matched controls. Of the gender-referred individuals, 38.2% had proceeded to GR interventions ([table 1](#)).

The all-cause mortality rate among gender-referred individuals was 0.81 per 1000 person-years, while controls had a rate of 0.40 per 1000 person-years. The suicide mortality rate among gender-referred individuals was 0.51 per 1000 person-years, while controls had a rate of 0.12 per 1000 person-years.

In multivariate analyses accounting for differences in follow-up times, the all-cause mortality of gender-referred individuals did not differ from that of controls when registered sex and year of birth were accounted for or when psychiatric treatment contacts were added to the model ([table 2](#)). Mortality was predicted by the male sex and an increasing amount of psychiatric treatment contacts.

When only registered sex and year of birth were controlled for, the HR for suicide mortality greatly increased in the gender-referred group. However, when the number of specialist-level psychiatric treatment contacts was added to the model, the difference between cases and controls levelled out. Death by suicide was significantly predicted by a high number of psychiatric treatment contacts, and borderline significantly predicted by male sex and earlier birth year ([table 3](#)).

To explore the role of GR, models accounting for sex, year of birth and psychiatric treatment were repeated by dividing the GR group into those who had and those who had not proceeded to GR. Adjusted HRs for all-cause mortality were 1.4 (95% CI 0.6 to 3.3;  $p = 0.5$ ) in the GR- group and 0.7 (95% CI 0.2 to 2.0;  $p = 0.5$ ) in the GR+ group, as compared with the controls. Adjusted HRs for suicide mortality were 3.2 (95% CI 1.0 to 10.2;  $p = 0.05$ ) and 0.8 (95% CI 0.2 to 4.0;  $p = 0.8$ ), respectively.

### DISCUSSION

In this nationally representative, register-based, long-term, follow-up study, the all-cause mortality of gender-referred adolescents did not statistically significantly differ from that of matched population controls. Suicide mortality first appeared to

**Table 1** Sample characteristics (% , n)

|   | All<br>n=18 726 | Cases<br>n=2083 | Controls<br>n=16 643 | P value<br>Cases versus controls (where appropriate) |
|---|-----------------|-----------------|----------------------|--|
| Registered males  | 49.0 (9185)     | 41.3 (860)      | 50.0 (8325)          | <b>&lt;0.001</b>                                     |
| Death during follow-up                                  | 0.3 (55)        | 0.5 (11)        | 0.3 (44)             | 0.05   |
| Suicide   | 0.1 (20)        | 0.3 (7)         | 0.1 (13)             | <b>0.004</b>   |
| Number of contacts to specialist-level psychiatric care |                 |                 |                      | <b>&lt;0.001</b>                                     |
| None  | 69.0 (12 928)   | 28.6 (595)      | 74.1 (12 333)        |  |
| 1–5   | 8.2 (1537)      | 9.6 (200)       | 8.0 (1337)           |  |
| 6–25  | 8.1 (1518)      | 15.2 (317)      | 7.2 (1201)           |  |
| 26–100  | 8.0 (1490)      | 20.5 (426)      | 6.4 (1064)           |  |
| 101+  | 6.7 (1253)      | 26.2 (545)      | 4.3 (708)            |  |
| Hormonal or surgical gender reassignment interventions* | 4.3 (814)*      | 38.2 (796)      | 0.1 (18)*            |  |

p-values statistically significant at level  $< 0.01$  are highlighted in bold.  
\*Controls may have obtained corresponding hormonal treatments (androgen, oestrogen, antiandrogen) or mastectomy because of any other relevant condition not counted as gender reassignment.

**Table 2** Predictors of all-cause mortality among persons who contacted specialised gender identity units at age less than 23 years

| Group   | Model 1. Group membership, registered sex, birth year |              | Model 2. Group membership, registered sex, birth year and contact with specialist-level psychiatric care |                  |
|---|---|--------------|--|------------------|
|   | HR (95% CI)   | P value      | HR (95% CI)  | P value          |
| Controls                                      | Ref   |              | Ref  |                  |
| Gender-referred                               | 2.0 (1.1 to 4.0)                                      | 0.03         | 1.0 (0.5 to 2.0)   | 1.0              |
| Registered sex male                           | 2.3 (1.3 to 4.1)                                      | <b>0.004</b> | 2.7 (1.5 to 4.9)   | <b>0.001</b>     |
| Later birth year                              | 1.0 (0.9 to 1.1)                                      | 0.9          | 1.0 (0.9 to 1.1)   | 0.9              |
| Contacts to specialist-level psychiatric care | –   | –            |  |                  |
| None  |   |              | Ref  |                  |
| 1–5   |   |              | 2.7 (1.1 to 6.7)   | 0.04             |
| 6–25  |   |              | 5.7 (2.7 to 11.8)  | <b>&lt;0.001</b> |
| 26–100  |   |              | 4.0 (1.7 to 9.4)   | <b>0.001</b>     |
| 101+  |   |              | 6.8 (3.0 to 15.4)  | <b>&lt;0.001</b> |

p-values statistically significant at level <0.01 are highlighted in bold

be much higher among gender-referred participants; however, the association was fully explained by psychiatric treatment history. All-cause and suicide mortalities did not differ between those gender referred who had and had not proceeded to GR when psychiatric treatment history was accounted for.

**Table 3** Predictors of suicide mortality among persons who contacted specialised gender identity units at age less than 23 years

| Group   | Model 1. Group membership, registered sex, birth year |              | Model 2. Group membership, registered sex, birth year and contact with specialist-level psychiatric care |                  |
|---|---|--------------|--|------------------|
|   | HR (95% CI)   | P value      | HR (95% CI)  | P value          |
| Controls                                      | Ref   |              | Ref  |                  |
| Gender-referred                               | 4.3 (1.7 to 10.7)                                     | <b>0.002</b> | 1.8 (0.6 to 4.8)   | 0.3              |
| Registered sex male                           | 3.0 (1.1 to 8.2)                                      | 0.04         | 3.8 (1.4 to 10.5)  | 0.01             |
| Later birth year                              | 0.9 (0.8 to 1.0)                                      | 0.02         | 0.9 (0.8 to 1.0)   | 0.01             |
| Contacts to specialist-level psychiatric care | –   | –            |  |                  |
| None  |   |              | Ref  |                  |
| 1–5   |   |              | 1.3 (0.2 to 10.7)  | 0.8              |
| 6–25  |   |              | 3.9 (1.0 to 16.0)  | 0.06             |
| 26–100  |   |              | 5.6 (1.5 to 21.0)  | 0.01             |
| 101+  |   |              | 11.1 (3.2 to 38.3)   | <b>&lt;0.001</b> |

p-values statistically significant at level <0.01 are highlighted in bold

### All-cause and suicide mortalities of gender-referred adolescents as compared with a matched control population

The all-cause mortality rate among gender-referred individuals aged less than 23 years (0.81 per 1000 person-years) was much lower than that reported in earlier studies among adults diagnosed with GD.<sup>9–14 21</sup> This discrepancy is most likely due to the young age of our participants, who therefore had not yet developed age-related illnesses such as cancer or cardiovascular diseases. Moreover, substance abuse problems, which have been associated with transgender individuals' mortality in other countries,<sup>10</sup> are rare among transgender youth in Finland,<sup>25</sup> as is HIV/AIDS.<sup>26</sup> Risks related to GR<sup>27 28</sup> and lifestyle choices may not have been actualised in our sample. We are not aware of comparable studies of all-cause mortality in adolescent patients with clinical GD.

In the gender-referred group, 0.3% died by suicide. This is significantly lower than the reported figures for suicidal ideation and self-harm among adolescents with GD.<sup>15–17</sup> The suicide mortality rate was 0.51 per 1000 person-years in our sample. Our rate was slightly higher than the British data of 0.13 per 1000 person-years<sup>18</sup>; however, our follow-up period was longer. Studies examining adults diagnosed with GD have reported suicide mortality rates ranging from being roughly comparable to those in our findings to being approximately fivefold higher.<sup>9–13 21</sup> The three-step theory of suicide posits that suicide (attempt) may follow if a combination of pain and hopelessness overwhelms connectedness, and if the individual has capability for suicide.<sup>29</sup> Meanwhile, adolescents presenting with GD may not necessarily feel disconnected, but actually find new connectedness and social support after 'coming out',<sup>2</sup> but they may also be less capable of suicide than adults. Nevertheless, suicide mortality among young people seeking GR is rare.

### Mortality and psychiatric morbidity

In this study, all-cause mortality was predicted through psychiatric treatment, with a higher risk associated with increased treatment needs and the male sex. Psychiatric disorders are associated with increased burdens of somatic illnesses<sup>30</sup> and suicide.<sup>22</sup> Our findings concord with these past pieces of evidence and show that the first observed difference between the gender-referred group and matched controls in suicide mortality levelled out when psychiatric treatment was considered. In fact, the novel contribution of this study is showing that suicide mortality associates with increased psychiatric needs; this is an important finding if we consider the failure of previous studies on mortality among patients with GD to account for psychiatric morbidities. In light of our findings, experiencing GD significant enough to seek GR appears to not be associated with increased suicide mortality, but suicides appear to be explained by psychiatric morbidities.

### Impact of GR on mortality among gender-referred adolescents

Neither GR-treated gender-referred participants nor those who had not proceeded to GR differed from controls regarding all-cause mortality when confounding by different follow-up times, sex, birth year and psychiatric treatment was accounted for. There is limited and partially conflicting evidence regarding the long-term somatic safety of GR. For example, there is no conclusive evidence regarding the risk of malignancy associated with hormone therapy. Oestrogen is known to increase the risk of thromboembolism; however, thromboembolic events in transgender women are rare. Changes in body mass index (BMI), lipid levels and blood pressure are also possible.<sup>27 28</sup> Considering



the young age of our sample population, we cannot conclude the somatic safety of GR because any potential impact on mortality would likely require follow-up periods of up to several decades. Since the increase in young people seeking GR has mainly occurred during the last decade, the mean and follow-up times remained modest in this sample.

Most importantly, when psychiatric treatment needs, sex, birth year and differences in follow-up times were accounted for, the suicide mortality of both those who proceeded and did not proceed to GR did not statistically significantly differ from that of controls. This does not support the claims<sup>5,6</sup> that GR is necessary in order to prevent suicide. GR has also not been shown to reduce even suicidal ideation<sup>7,8</sup>, and suicidal ideation is not equal to actual suicide risk.<sup>29</sup> To the best of our knowledge, the impact of GR on suicide mortality among gender-referred adolescents has not been reported in earlier studies. In an earlier study by Dhejne *et al.*,<sup>11</sup> even when psychiatric morbidity was controlled for, participants diagnosed as transsexual in adulthood who had undergone both hormonal and surgical GR displayed increased suicide mortality compared with matched population controls. Nonetheless, these authors focused on patients treated before 2002. More recent cohorts, particularly adolescents, may differ from those in earlier decades, and stress related to gender identity itself may be lower presently because of decreasing prejudice.

When psychiatric treatment history is considered, GD significant enough to result in contact with specialised gender identity services during adolescence does not appear to be predictive of all-cause or suicide mortality. Psychiatric morbidities are also common in this population. Therefore, the risk of suicide related to transgender identity and/or GD per se may have been overestimated.

### Strengths and limitations

The strengths of this study include a large nationally representative sample, an inclusion period of three decades, the use of matched population controls and a long follow-up period. The register datasets used display no loss during follow-up because reporting to these registers is mandatory for health authorities and citizens cannot opt out. Persons who may have permanently emigrated would not emerge in registers anymore, and there is no reason to expect that emigration from Finland would relate to GD. This study also considered contact with specialist-level psychiatric care as a reliable indicator of severe mental disorders, with longer or more intensive treatments reflecting greater severity.

The limitations of this study include the non-consideration of confounding factors such as social support, BMI or lifestyle factors. Psychiatric morbidity was analysed on the level of intensity of specialist-level psychiatric contact without disentangling causes of using the services. However, regardless of actual diagnoses set, specialist-level psychiatric treatment contact indicates severe psychiatric morbidity, as specialist-level services are reserved to severe disorders, and national guidelines exist to ensure this similar threshold throughout the country. Some of the psychiatric morbidity warranting specialist-level psychiatric treatment may have emerged only after the contact to gender identity services and may therefore theoretically not truly represent confounding but a pathway linking GD to mortality. However, register data cannot truly reveal the timing of onset of a disorder, and totally disentangling between psychological phenomena may also be challenging; therefore, we have simply called psychiatric morbidity a confounder.

A further limitation is that although the follow-up time in this study was longer than that in many other studies on outcomes in clinical GD adolescent samples, the mean follow-up time of six years could be considered relatively short. Despite the large amounts of data, deaths were rare in our sample, limiting the possibility of more fine-tuned analyses. Moreover, because the register authorities do not allow researchers to track changes in the registered sex, we were not able to run analyses stratified by birth sex, which is a limitation, particularly given the known sex differences in suicide mortality. However, owing to data security and privacy issues, cell frequencies below a certain limit must not be reported. This would have prevented further stratification anyway. Finally, our sample represented clinically gender-referred participants; thus, the findings cannot be generalised to all transgender-identifying youths.

### Clinical implications

It is of utmost importance to identify and appropriately treat mental disorders in adolescents experiencing GD to prevent suicide. Health policies need to ensure that accurate information is provided to professionals along these lines.

**Contributors** S-MR: writing—original draft (lead), formal analysis (equal), conceptualisation (equal). KT: writing—reviewing and editing (supporting), methodology (supporting), conceptualisation (supporting). TH: methodology (lead), writing—reviewing and editing (supporting), data curation (supporting). RK: writing—reviewing and editing (lead), data curation (lead), funding acquisition (lead), supervision (lead), conceptualisation (equal), formal analysis (equal), guarantor.

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**Data availability statement** Data may be obtained from a third party and are not publicly available. Researchers can apply for Finnish register data at [www.findata.fi](http://www.findata.fi).

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