

## Factors influencing the risk of repeat termination of pregnancy: A register-based study in Finland

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### ABSTRACT

**Objective:** This study aimed to assess how factors such as sociodemographic characteristics, termination of pregnancy (TOP) related factors and contraception affect the risk of repeat TOP.

**Materials and method:** This is a nationwide register-based study of 193,741 women who had TOP(s) during 1987–2015, using the Finnish Register of Induced Abortions. The risk of various factors, such as age, marital status, residence, parity, TOP related factors and contraception, was assessed separately for each repeat TOP. Cox proportional hazard model was used to estimate risk of different factors for repeat TOPs.

**Results:** 21% of the women having TOP had repeat TOPs during the years 1987–2015. Among women with repeat TOPs, more than 70% had one repeat TOP and the rest had two or more. Older, married and rural or semi-urban women had reduced risk of repeat TOPs. Adjusted risk for one repeat TOP was higher among parous women (HR 1.67, 95% CI 1.61–1.72). No significant risk for repeat TOP was observed by method in sub-analysis for the recent period after 2006. Women using less reliable (HR 1.14, 95% CI 1.06–1.23) and unreliable (HR 1.33, 95% CI 1.23–1.43) contraception had increased risk of repeat TOP than women using reliable contraception.

**Conclusion:** Older age, being married, residing in rural or semi-urban areas and using reliable contraception were found to be protective factors for repeat TOPs whereas, parous women had higher risk for repeat TOPs. Proper counselling regarding contraception and use of reliable contraception immediately after TOP should be encouraged.

### Introduction

Termination of pregnancy (hereafter TOP) is a common procedure performed among women, that might have significant consequences for sexual and reproductive health. Earlier literature has documented that, despite minimal consequences, TOP has been linked to long-term effects, specifically preterm birth and low birth weight in subsequent births [1,2,3]. The risk of adverse birth outcomes increased with the additional number of TOPs [1,3,4]. Increased knowledge of risk factors associated with repeat TOPs is important to prevent unintended pregnancy and thus the repeat TOPs, which ultimately helps ensure the health and well-being of women. However, studies exploring the factors associated with repeat TOPs have been poorly understood and limited.

Around 73 million TOPs were performed globally each year in

2015–2019, 61% of them for unintended pregnancies [5]. The number of TOPs has remained stable or decreased over recent years in many European countries, including Finland [5,6]. Among women having had TOP, the proportion of repeat TOPs is high but varies by country. For example, repeat TOPs account for 50% of women having TOP in the United States, 43% in England and Wales, 46% in Sweden and 37% in Norway [7–10]. In Finland, 37% of women who had TOP in 2021 had gone at least one previous TOP [6], whereas, it was 26% in 1987 (unpublished data). According to the Finnish legislation dates from 1970 and 1985, a pregnancy can be terminated for social, medical or ethical grounds up to 20 weeks of gestation and up to 24 weeks, in cases of confirmed fetal anomalies [11]. Approval from one or two physician is required to terminate a pregnancy till 12th gestational week however, after 12 weeks, approval from national authority is required [11].

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Evidence from countries with high quality health services (e.g. Western Europe, USA, Canada and New Zealand) demonstrates the link between various factors and repeat TOP. Several cross-sectional studies [9,12–15] showed that repeat TOPs are associated with age, higher parity and the use of contraception, in line with the results of different prospective and register-based studies [16–20]. Other factors, such as smoking, alcohol and substance abuse, conflict with a partner and social deprivation, have also been associated with repeat TOPs [12–14,16]. Most of the existing studies are small-scale and cross-sectional, and large studies are limited. Although many studies have explored the risk of repeat TOP by sociodemographic factors [9,13,19], most have not considered the time interval between TOPs [19,20].

Using the large nationwide database, therefore, this study attempts to provide insights into how different factors such as sociodemographic factors, parity, TOP related factors and the use of contraception affect the risk of repeat TOP.

## Materials and method

This is a nationwide register-based study among Finnish women who

had at least one TOP during the period 1987–2015. Women having had TOP were identified from the Finnish Register of Induced Abortions, maintained by Finnish Institute of Health and Welfare (THL). The physicians who perform TOPs are obliged to report each case to the register using a specific form. The register was started in 1950, and computerized data on all TOPs are available from 1983. The register contains information on the woman's background, gestational age at TOP, indications for the TOP, dates, procedures and complications arising during the procedure. The information contained in the register is complete and highly reliable [20].

All the TOPs over the period 1987–2015 ( $n = 368,981$ ) were identified from the Finnish Register of Induced Abortions. The cases with missing or incomplete personal identification code ( $n = 6,304$ , 1.7%), the TOPs missing an exact date of procedure ( $n = 65,739$ , 17.8%), and those with erroneous history of procedure ( $n = 40,637$ , 13.4%) were removed from the dataset. Those cases lacking an exact procedure date were mainly during the earlier years of TOP register. Similarly, the TOPs with fetal indication ( $n = 6,779$ , 1.8%) were also removed from the dataset, as these were likely to be different from TOPs with other indications (see Fig. 1).

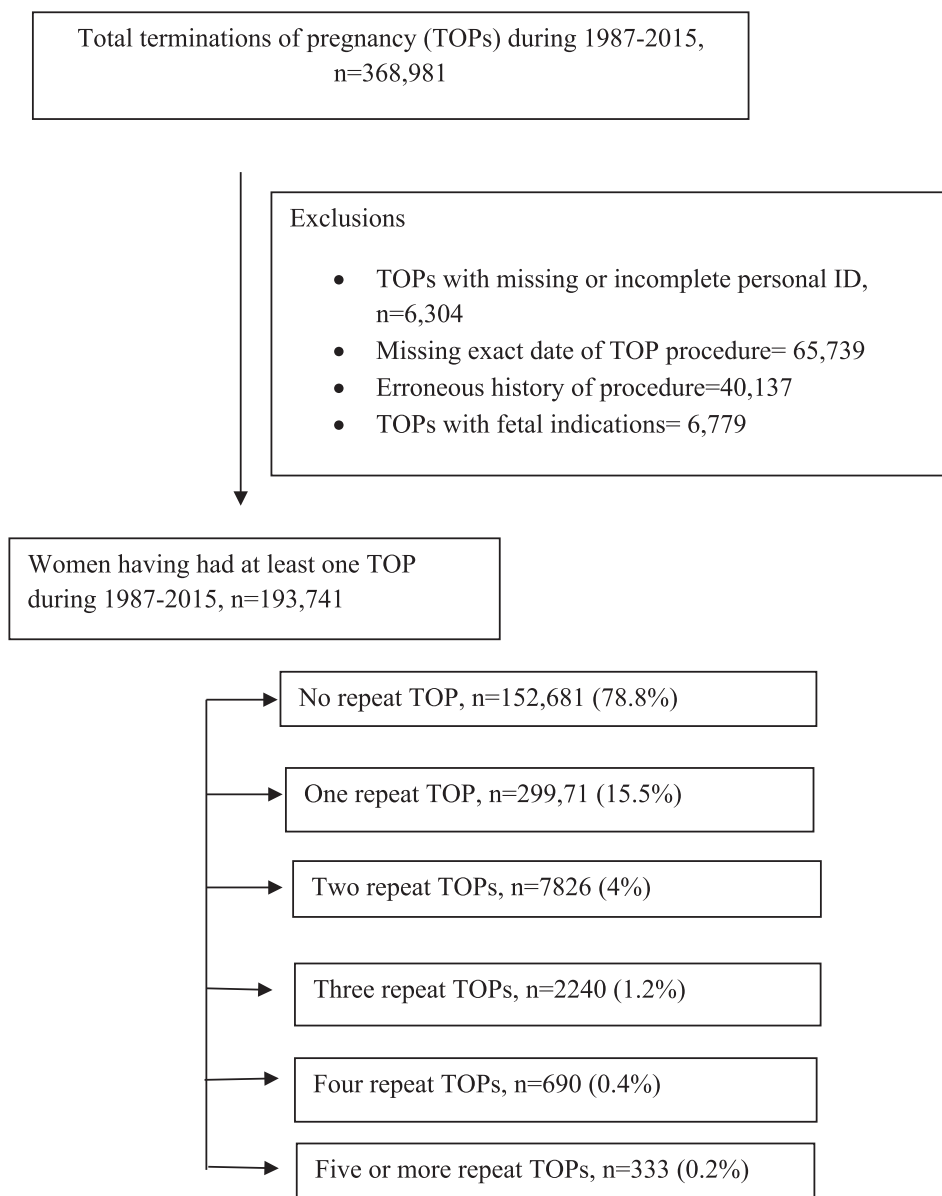


Fig. 1. A flow diagram detailing the study groups among women having had termination of pregnancy (TOP) in Finland between 1987 and 2015.

In this study, women having had at least one TOP ( $n = 193,741$ ) were identified as the study cohort. Those women who had repeat TOPs were identified using the personal identification number from the Register. The women who had had the TOPs since 1987 were followed up to the end of 2015 to identify subsequent TOPs. For the sub-analysis, the most recent time-period 2006–2015 was selected based on the distribution of repeat TOPs to see how currently the different factors influence the risk of repeat TOPs.

The primary outcome for this study was the repeat TOP. Women with a history of TOP were classified according to number of TOPs as: no repeat TOP (one TOP,  $n = 152,681$ , 78.8%); one repeat TOPs (two TOPs,  $n = 29,971$ , 15.5%); two repeat TOPs (three TOPs,  $n = 7826$ , 4%); three repeat TOPs (four TOPs,  $n = 2240$ , 1.2%); four repeat TOPs (five TOPs,  $n = 690$ , 0.4%); and five or more repeat TOPs (six or more TOPs,  $n = 333$ , 0.2%). No repeat TOP was used as a comparison group.

The predictor variables were also identified using the Register of Induced Abortions. The background variables considered were the women's age, marital status and residence of municipality, parity, and TOP related characteristics, including gestational age at the TOP, grounds for the TOP, the method used, and the prior use of contraception. The urbanity of residence of municipality was classified as rural, semi-urban, urban and abroad, following Statistics Finland. Methods of contraception used before the TOP, which indicates the use at the time of conception were classified into three categories, reliable, less reliable and unreliable (including no use). Long-acting reversible contraceptive (LARC) methods, including intrauterine contraception and implant, hormonal methods and sterilization were classified as reliable; barrier method (condom) was classified as less reliable, as its effectiveness depends on correctness of use; and unreliable methods included those using no or other rare methods of contraception, as well as those where the method was unknown. The study period was very long and included the period before medical methods were introduced. Therefore, for sub-analysis, we divided it into two periods based on the distribution of repeat TOPs overtime. As the share of repeat TOPs plateaued in 2005, the time-period was divided into two periods as 1987–2005 (increasing repeat TOPs) and 2006–2015 (stagnant repeat TOPs).

### Statistical analysis

Descriptive analysis was done using cross tabulation to see the differences between the study groups, with a chi-squared test used for the statistical significance. The level of significance was set at  $<0.01$ . Univariate and multivariate Cox proportional regression models were used to assess the effect of different factors on the repeat TOPs such as sociodemographic factors, the history of the TOP, including method and gestational age at TOP, and contraception used before the TOP. In the multivariate analysis, all the selected factors were added into the model. Hazard ratios and a 95% confidence interval were calculated. Additionally, Kaplan-Meier curve was used to assess the cumulative risk of first repeat TOP over the study period. A sub-analysis was performed taking into account the period from 2006 to 2015 using the same analysis method as for whole study period. IBM SPSS Statistics version 27 was used for all statistical analysis in this study.

### Ethical approval

Permission for the study was obtained from the Finnish Institute for Health and Welfare (THL) in October 2010 (dnro THL/1383/5.05.00/2009), September 2014 (dnro THL/1241/6.02.00/2014) and May 2017 (dnro THL/646/6.02.00/2017).

### Results

A total of 193,741 women who had TOP(s) in Finland during 1987–2015 were included in the study. Among them, 78.8% had only one TOP, 15.5% one repeat TOPs and 5.7% had two or more repeat TOPs. The number of repeat TOPs ranged from one to thirteen over the 28-year period. All the factors including demographic and TOP-related

characteristics differed significantly between the no repeat TOP and repeat TOP group (Table 1). Younger women, unmarried or single women and women residing in urban areas had higher number of repeat TOPs (Table 1). Repeat TOPs, especially two or more repeat TOPs were markedly higher in recent time-period, 2006–2015 (Table 1).

The median time difference between the TOPs ranged between 2.08 and 3.83 years (Table 2). 17% of repeat TOPs were performed within less than a year of the first TOP, 46% within 1–5 years and 37% after 5 years. In the Kaplan Meier analysis, there was a higher proportion of a single repeat TOP in the shorter time between TOPs among young women.

All the risk factors for repeat TOPs were reduced among women aged 20 years or over compared to the women under 20 (Table 3). Compared to the single or unmarried women, the married or cohabiting women

**Table 1**

Descriptive characteristics of women having had repeat termination of pregnancy (TOP) in Finland between 1987 and 2015 ( $n = 193,741$ ).

|   | No repeat TOP<br>n = 152,681<br>(%) | One repeat TOP<br>n = 29,971<br>(%) | Two or more repeat TOPs<br>n = 11 089<br>(%) | Total<br>n = 193,741<br>(%) | P-value* |
|---|-------------------------------------|-------------------------------------|--|-----------------------------|----------|
| Age                                     |                                     |                                     |  |                             |          |
| ≤19                                     | 23.3                                | 36.3                                | 49.7   | 26.8                        | <0.01    |
| 20–24                                   | 25.7                                | 32.3                                | 32.5   | 27.1                        |          |
| 25–29                                   | 17.5                                | 16.9                                | 12.3   | 17.1                        |          |
| 30–34                                   | 14.5                                | 9.5                                 | 4.2  | 13.1                        |          |
| 35–39                                   | 12.1                                | 4.2                                 | 1.2  | 10.2                        |          |
| ≥40                                     | 7.0                                 | 0.9                                 | 0.1  | 5.6                         |          |
| Marital status                          |                                     |                                     |  |                             |          |
| Unmarried/single                        | 72.5                                | 84.6                                | 89.6   | 75.3                        | <0.01    |
| Married/cohabiting                      | 26.8                                | 15.1                                | 10.2   | 24.1                        |          |
| Unknown                                 | 0.1                                 | 0.0                                 | 0.0  | 0.1                         |          |
| Missing                                 | 0.5                                 | 0.3                                 | 0.2  | 0.5                         |          |
| Municipality of residence               |                                     |                                     |  |                             |          |
| Urban                                   | 71.2                                | 73.4                                | 73.8   | 71.7                        | <0.01    |
| Semi-urban                              | 14.2                                | 13.3                                | 13.3   | 14.0                        |          |
| Rural                                   | 14.5                                | 13.3                                | 12.9   | 14.3                        |          |
| Abroad                                  | 0.1                                 | 0.0                                 | 0.0  | 0.1                         |          |
| Parity                                  |                                     |                                     |  |                             |          |
| No                                      | 56.6                                | 64.1                                | 66.6   | 58.4                        | <0.01    |
| Yes                                     | 40.8                                | 33.0                                | 30.9   | 39.0                        |          |
| Missing                                 | 2.6                                 | 2.9                                 | 2.5  | 2.6                         |          |
| Gestational age at TOP                  |                                     |                                     |  |                             |          |
| ≤12 weeks                               | 95.8                                | 94.6                                | 93.9   | 95.5                        | <0.01    |
| >12 weeks                               | 4.2                                 | 5.4                                 | 6.1  | 4.5                         |          |
| Method                                  |                                     |                                     |  |                             |          |
| Surgical                                | 54.7                                | 59.6                                | 63.1   | 55.9                        | <0.01    |
| Medical (available since 2000)          | 40.2                                | 34.0                                | 30.4   | 38.7                        |          |
| Others                                  | 0.3                                 | 0.2                                 | 0.3  | 0.3                         |          |
| Missing                                 | 4.8                                 | 6.1                                 | 6.2  | 5.1                         |          |
| Method of contraception used before TOP |                                     |                                     |  |                             |          |
| Reliable                                | 5.4                                 | 2.7                                 | 1.4  | 4.8                         | <0.01    |
| Less reliable                           | 49.9                                | 47.6                                | 45.5   | 49.3                        |          |
| Unreliable                              | 44.7                                | 49.6                                | 53.1   | 45.9                        |          |
| Indications for TOP                     |                                     |                                     |  |                             |          |
| Social                                  | 97.9                                | 97.6                                | 97.3   | 97.8                        | <0.01    |
| Medical (women)                         | 0.6                                 | 0.3                                 | 0.1  | 0.5                         |          |
| Ethical                                 | 0.0                                 | 0.0                                 | 0.0  | 0.1                         |          |
| Missing                                 | 1.5                                 | 2.0                                 | 2.5  | 1.6                         |          |
| Time-period                             |                                     |                                     |  |                             |          |
| 1987–2005                               | 65.8                                | 49.4                                | 30.1   | 61.2                        | <0.01    |
| 2006–2015                               | 34.2                                | 50.6                                | 69.9   | 38.8                        |          |

\*P-value < 0.01 in Chi square test.

**Table 2**

Time interval between repeat termination of pregnancy (TOP) performed in Finland between 1987 and 2015 (n = 41,060).

| Time difference between TOPs      | Median (IQR), years | <1 year, n = 7,022 (%) | 1–5 years, n = 18,872 (%) | >5 years, n = 15,166 (%) |
|-----------------------------------|---------------------|------------------------|---------------------------|--------------------------|
| The first and second TOPs         | 3.83, 1.67–7.50     | 65.8                   | 70.4                      | 79.5                     |
| The second and third TOPs         | 3.00, 1.33–5.83     | 22.4                   | 20.6                      | 15.6                     |
| The third and fourth TOPs         | 2.58, 0.92–4.17     | 7.6                    | 6.1                       | 3.6                      |
| The fourth and at least five TOPs | 2.08, 0.92–4.17     | 4.1                    | 2.9                       | 1.3                      |

had a reduced risk of one repeat TOP (adjusted HR 0.80, 95% CI 0.77–0.83) (Table 3). Similar reduced risks were seen for the two, three and four repeat TOPs compared to no repeat TOP. Semi-urban and rural women had decreased risk of repeat TOPs compared to urban women, when comparing one, two, three and four repeat TOPs to no repeat TOP. Moreover, all the adjusted risks of repeat TOPs were higher among parous women than among non-parous women.

Compared to women who had had one or more surgical TOPs, women who had had one or more medical TOPs had a higher risk of one repeat TOP (adjusted HR 1.30, 95% CI 1.26–1.33) (Table 3). Increased adjusted risks were found with additional number of repeat TOPs compared to no repeat TOP. Non-significant risk of one repeat TOP was found among women who had had a TOP after 12 weeks than among those who had the TOP at or before 12 weeks. However, all other adjusted risks for two or more repeat TOPs were lower among the women who had the TOP after 12 weeks than among the women with no repeat TOP. The risks for one and two repeat TOPs were higher among the women using less reliable contraception or unreliable contraception

**Table 3**

Hazard ratios (HR) and 95 % Confidence intervals for the risk of repeat termination of pregnancy (TOP) among the women having had TOP in Finland during 1987–2015.

|                                    | One repeat TOP vs no repeat TOP |                      | Two repeat TOPs vs no repeat TOP |                      | Three repeat TOPs vs no repeat TOP |                      | Four repeat TOPs vs no repeat TOP |                      |
|------------------------------------|---------------------------------|----------------------|----------------------------------|----------------------|------------------------------------|----------------------|-----------------------------------|----------------------|
|                                    | Crude HR (95% CI)               | Adjusted HR (95% CI) | Crude HR (95% CI)                | Adjusted HR (95% CI) | Crude HR (95% CI)                  | Adjusted HR (95% CI) | Crude HR (95% CI)                 | Adjusted HR (95% CI) |
| Age                                |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| ≤19                                | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| 20–24                              | 0.87<br>(0.84–0.89)             | 0.78<br>(0.76–0.80)  | 0.68<br>(0.65–0.72)              | 0.55<br>(0.52–0.59)  | 0.58<br>(0.53–0.64)                | 0.41 (0.37–0.46)     | 0.46<br>(0.39–0.55)               | 0.28 (0.23–0.34)     |
| 25–29                              | 0.67<br>(0.65–0.69)             | 0.55<br>(0.53–0.58)  | 0.40<br>(0.37–0.43)              | 0.27<br>(0.25–0.29)  | 0.26<br>(0.22–0.30)                | 0.14 (0.12–0.16)     | 0.21<br>(0.16–0.27)               | 0.09 (0.07–0.12)     |
| 30–34                              | 0.46<br>(0.44–0.48)             | 0.36<br>(0.35–0.38)  | 0.17<br>(0.16–0.19)              | 0.10<br>(0.09–0.12)  | 0.08<br>(0.06–0.11)                | 0.04 (0.03–0.05)     | 0.04<br>(0.22–0.07)               | 0.01 (0.01–0.03)     |
| 35–39                              | 0.25<br>(0.23–0.26)             | 0.19<br>(0.18–0.20)  | 0.06<br>(0.05–0.08)              | 0.03<br>(0.03–0.04)  | 0.01<br>(0.01–0.03)                | 0.01<br>(0.000–0.01) | 0.00<br>(0.00–0.03)               | 0.00 (0.00–0.01)     |
| ≥40                                | 0.09<br>(0.07–0.09)             | 0.07<br>(0.06–0.07)  | 0.01<br>(0.01–0.02)              | 0.01<br>(0.00–0.01)  | 0.00                               | 0.00                 | 0.00                              | 0.00                 |
| Marital status                     |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| Unmarried/single                   | Ref                             | Ref                  | Ref                              | Ref                  | Ref                                | Ref                  | Ref                               | Ref                  |
| Married/cohabiting                 | 0.53<br>(0.52–0.55)             | 0.80<br>(0.77–0.83)  | 0.35<br>(0.32–0.37)              | 0.74<br>(0.68–0.81)  | 0.27<br>(0.23–0.31)                | 0.68 (0.57–0.81)     | 0.24<br>(0.18–0.31)               | 0.74 (0.54–1.02)     |
| Municipality of residence          |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| Urban                              | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| Semi-urban                         | 0.87<br>(0.84–0.90)             | 0.87<br>(0.84–0.90)  | 0.85<br>(0.80–0.91)              | 0.82<br>(0.76–0.87)  | 0.83<br>(0.73–0.93)                | 0.75 (0.65–0.85)     | 0.72<br>(0.57–0.91)               | 0.62 (0.48–0.79)     |
| Rural                              | 0.82<br>(0.79–0.85)             | 0.83<br>(0.80–0.86)  | 0.77<br>(0.72–0.82)              | 0.76<br>(0.71–0.81)  | 0.68<br>(0.60–0.77)                | 0.62 (0.54–0.71)     | 0.62<br>(0.49–0.79)               | 0.54 (0.42–0.70)     |
| Parity                             |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| No                                 | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| Yes                                | 0.72<br>(0.70–0.74)             | 1.67<br>(1.61–1.72)  | 0.61<br>(0.56–0.64)              | 2.59<br>(2.43–2.76)  | 0.58<br>(0.53–0.64)                | 3.63 (3.23–4.08)     | 0.61<br>(0.52–0.71)               | 5.11 (4.15–6.30)     |
| Method                             |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| Surgical                           | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| Medical                            | 1.41<br>(1.37–1.44)             | 1.30<br>(1.26–1.33)  | 1.78<br>(1.79–1.87)              | 1.59<br>(1.51–1.68)  | 2.10<br>(1.90–2.32)                | 1.82 (1.63–2.03)     | 3.03<br>(2.54–3.62)               | 2.54 (2.07–3.17)     |
| Gestational age at the time of TOP |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| ≤12 weeks                          | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| >12 weeks                          | 1.28<br>(1.22–1.35)             | 0.97<br>(0.92–1.03)  | 1.43<br>(1.30–1.57)              | 0.86<br>(0.77–0.95)  | 1.65<br>(1.39–1.95)                | 0.81 (0.67–0.98)     | 1.91<br>(1.44–2.53)               | 0.69 (0.49–0.96)     |
| Method of contraception before TOP |                                 |                      |                                  |                      |                                    |                      |                                   |                      |
| Reliable                           | ref                             | ref                  | ref                              | ref                  | ref                                | ref                  | ref                               | ref                  |
| Less reliable                      | 1.48<br>(1.38–1.59)             | 1.14<br>(1.06–1.23)  | 2.54<br>(2.10–3.07)              | 1.43<br>(1.18–1.73)  | 2.45<br>(1.72–3.49)                | 1.05 (0.73–1.51)     | 7.28<br>(2.33–22.72)              | 2.87 (0.91–9.04)     |
| Unreliable                         | 1.74<br>(1.62–1.87)             | 1.33<br>(1.23–1.43)  | 3.28<br>(2.71–3.96)              | 1.80<br>(1.48–2.18)  | 3.37<br>(2.37–4.79)                | 1.39 (0.97–1.99)     | 12.64<br>(4.06–39.39)             | 4.73<br>(1.51–14.84) |

Adjusted for each predictor variables.

before the TOP than for those who used reliable methods. However, the significance was lost for the risk of three and four repeat TOPs.

In the sub-analysis on women having had TOPs in the recent time-period 2006–2015, the adjusted results were similar for the demographic factors and parity, as in the results from whole study period 1987–2015 (Table 4). However, there was a difference with regards to TOP related factors and contraception. No association was seen for the risk of all repeat TOPs compared to no repeat TOP by the TOP method (Table 4). Similarly, a slightly increased risk for one repeat TOP was found among women having had TOP after 12 gestational weeks.

**Table 4**

Adjusted Hazard ratios (HR) and 95 % Confidence intervals for the risk of repeat termination of pregnancy (TOP) among the women having had TOP in Finland during 2006–2015.

| Characteristics                           | One repeat TOPs vs no repeat TOP | Two repeat TOPs vs no repeat TOP | Three repeat TOPs vs no repeat TOP | Four repeat TOPs vs no repeat TOP |
|---|----------------------------------|----------------------------------|------------------------------------|-----------------------------------|
|   | HR (95% CI)                      | HR (95% CI)                      | HR (95% CI)                        | HR (95% CI)                       |
| <b>Age</b>                                |                                  |                                  |                                    |                                   |
| ≤19                                       | ref                              | ref                              | ref                                | ref                               |
| 20–24                                     | 0.70<br>(0.66–0.74)              | 0.51<br>(0.45–0.58)              | 0.39<br>(0.29–0.51)                | 0.30<br>(0.18–0.50)               |
| 25–29                                     | 0.48<br>(0.45–0.52)              | 0.29<br>(0.24–0.34)              | 0.13<br>(0.09–0.21)                | 0.16<br>(0.08–0.31)               |
| 30–34                                     | 0.36<br>(0.33–0.340)             | 0.12<br>(0.07–0.16)              | 0.10<br>(0.06–0.17)                | 0.03<br>(0.01–0.12)               |
| 35–39                                     | 0.22<br>(0.19–0.24)              | 0.06<br>(0.04–0.08)              | 0.05<br>(0.02–0.10)                | 0.00                              |
| ≥40                                       | 0.07<br>(0.05–0.09)              | 0.01<br>(0.01–0.04)              | 0.00                               | 0.00                              |
| <b>Marital status</b>                     |                                  |                                  |                                    |                                   |
| Unmarried/<br>single                      | Ref                              | Ref                              | Ref                                | Ref                               |
| Married/<br>cohabiting                    | 0.88<br>(0.82–0.94)              | 0.81<br>(0.69–0.95)              | 0.60<br>(0.41–0.89)                | 0.88<br>(0.44–1.75)               |
| <b>Municipality of residence</b>          |                                  |                                  |                                    |                                   |
| Urban                                     | Ref                              | Ref                              | Ref                                | Ref                               |
| Semi-urban                                | 0.88<br>(0.82–0.94)              | 0.81<br>(0.69–0.94)              | 1.12<br>(0.83–1.51)                | 0.50<br>(0.24–1.04)               |
| Rural                                     | 0.87<br>(0.81–0.94)              | 0.93<br>(0.79–1.09)              | 0.91<br>(0.65–1.29)                | 0.73<br>(0.38–1.41)               |
| <b>Parity</b>                             |                                  |                                  |                                    |                                   |
| No  | Ref                              | Ref                              | Ref                                | Ref                               |
| Yes                                       | 1.81<br>(1.71–1.93)              | 3.02<br>(2.65–3.44)              | 4.43<br>(3.35–5.87)                | 5.66<br>(3.43–9.35)               |
| <b>Method of TOP</b>                      |                                  |                                  |                                    |                                   |
| Surgical                                  | Ref                              | Ref                              | Ref                                | Ref                               |
| Medical                                   | 0.99<br>(0.93–1.06)              | 1.01<br>(0.88–1.15)              | 0.89<br>(0.68–1.16)                | 1.18<br>(0.71–1.97)               |
| <b>Gestational age at the time of TOP</b> |                                  |                                  |                                    |                                   |
| ≤12 weeks                                 | Ref                              | Ref                              | Ref                                | Ref                               |
| >12 weeks                                 | 1.11<br>(1.00–1.22)              | 1.11<br>(0.89–1.38)              | 0.98<br>(0.60–1.61)                | 0.94<br>(0.38–2.34)               |
| <b>Contraception before TOP</b>           |                                  |                                  |                                    |                                   |
| Reliable                                  | Ref                              | Ref                              | Ref                                | Ref                               |
| Reliable if used correctly                | 1.49<br>(1.17–1.90)              | 1.39<br>(0.79–2.47)              | 0.78<br>(0.29–2.13)                | –                                 |
| No reliable                               | 1.67<br>(1.31–2.13)              | 1.66<br>(0.94–2.95)              | 0.92<br>(0.34–2.51)                | –                                 |

Adjusted for each predictor variables.

Moreover, non-significant risks for two, three and four repeat TOPs were found by the gestational week at TOP. As in the whole period since 1987, increased adjusted risk for one repeat TOP was found among women who used less reliable or unreliable method of contraception compared to women who used reliable contraception method in the recent time-period. However, no significant risk for more than one repeat TOPs was found for the use of contraception (Table 4).

## Discussion

In this register-based study, 21% of the women who had had a TOP had repeat TOPs. Of those who had repeat TOPs, the proportion of women having one repeat TOP was more than 70%. Being older, married, residing in semi-urban or rural areas, and using reliable method of contraception were protective factors for repeat TOP, however, being parous was found to be a risk factor of repeat TOPs. In the sub-analysis considering the time period after 2006, no difference in risk of repeat TOPs was found by the method and gestational weeks at TOP except a slight and marginal risk for one repeat TOP after 12 gestational weeks.

The major strength of this study is the largest dataset for the longer period, covering all the TOPs performed in 1987–2015, using the Finnish Register of Induced Abortions. Our study period was quite long and there could be possibility of changes overtime with regards to repeat TOPs. Therefore, we performed sub-analyses for the most recent time-period 2006–2015. The quality and coverage of the data has been proven high [21,22]. The reliability study done by previous studies has shown that 99 percent of the index TOP information matched with the register data [16,23]. As all the TOPs during the study period were included, selection bias is likely to be minimal. In this study, TOPs performed due to fetal indications were excluded as they differ from other indications and might affect the future pregnancy.

Information on previous TOPs is routinely validated in the Finnish Register of Induced Abortions, but TOPs performed abroad or before 1983 might be underreported. However, the assumption is that there are relatively few such cases, and these are unlikely to affect our results. Socioeconomic status would have been of great interest as a factor likely to influence repeat TOP, but we could not include that in this study. The information was incomplete, with more than 50% of data on socioeconomic status missing from the register. As most of the study cohort are young and students, it is difficult to assess their socioeconomic status. The status of their parents or partners would be of interest, unfortunately, this information was also not available in the Register. A recent cross-sectional study from Sweden and a previous study from Finland reported association between low socio-economic status (low education level) and repeat TOPs [24,25]. In contrast, another Finnish study found no association between socioeconomic status and rate of repeat TOPs [16], however, it was reported that smoking was associated with increased risk of repeat TOP. In that study, the socioeconomic status was defined according to the type of occupation, and if no information on occupation was provided, educational level was transformed to socioeconomic status [16]. The difference in definition of socioeconomic status may cause the variation in results. Smoking is strongly associated with socioeconomic status and sometimes it can be used as a proxy [26].

In this study, all demographic and TOP-related characteristics differ significantly between the no repeat TOP and repeat TOPs. Older, married or cohabiting women and rural or semi-urban women had lower risk for repeat TOPs. Consistent with other studies [16,18,19], our study found a decreased risk of repeat TOPs in older women over 20 years old. However, there are several studies which conflict with our results [9,13–15,27]. Similarly, our finding that single or unmarried women had an increased risk of repeat TOPs, is similar to earlier studies [9,18,23]. Younger and unmarried women might have financial problems in having and using contraception, as well as in having a child. They might also think that a child might interfere with their future opportunities [28]. Women residing in semi-urban and rural areas were also seen to have a reduced risk of repeat TOPs in previous studies from

Finland [18,23]. Urban women might seek TOP services more often because of easy accessibility and availability of health services in those areas. There could also be differences in educational level, occupation and income as well as traditional norms between the rural and urban women, that might influence the likelihood of repeat TOP.

Being parous as a risk factor for repeat TOP is one of the other important findings of our study, and consistent with previous studies [15–17,20,27]. Parous women may have already reached their desired family size and seek more repeat TOPs because they do not want to take on another child [29]. It has also been documented in an earlier study that the TOP rate was at its peak at 6–8 months of postpartum, especially among young women and teenagers [30]. This might indicate that contraception use among youth and teenagers was not satisfactory.

In this study including the whole time period from 1987 to 2015, medical TOP was found as a risk factor for repeat TOPs. However, considering the time period after 2006, we found no significant difference in risk of repeat TOP by the TOP method, which corresponds to the result of another earlier study from Finland [23]. The earlier Finnish study also consider the time period after the medical TOP had been introduced. Medical TOPs can partly be carried out outside health facilities since no surgical procedure is required, and women might feel the procedure to be less painful, which could be possible reasons that women undergoing medical TOP might seek more TOPs. However, it could not be ignored that surgical TOP was more common in the early period of our study before 2006 and after that almost surgical TOPs have been replaced by medical TOP. In this study, no significant risk of repeat TOPs was found after a TOP performed above 12th gestational weeks, which is in line with a recent study [20]. In contrast with this result, however, a Finnish study [18] found the second trimester TOP was associated with repeat TOPs and also with repeat TOPs during the second trimester.

Women using reliable methods of contraception such as LARC, hormonal methods and sterilization showed reduced risk of repeat TOPs than those using less reliable and unreliable methods. Much earlier evidence supports our findings [16,17,19,20]. Intrauterine contraception after the TOP showed high efficacy in reducing the risk of repeat TOPs [16,23,31]. Further, previous studies reported reduced TOP rate among women using LARC methods than those using no LARC methods [32,33]. However, in a previous randomized study, specialist contraceptive counselling and provision after TOP increased the initial uptake of LARC methods but did not show any effect on repeat TOPs [34]. Further, it is possible that women using the LARC method might discontinue the method. A recent study [35] showed a greater discontinuation among women using implants and copper intrauterine device than among those using levonorgestrel-releasing intrauterine system. In addition, the immediate initiation of any contraceptive after a TOP, rather than not using any method, may possibly reduce the need for repeat TOPs [16,27].

## Conclusion

Older age, being married, rural or semi-urban residence and using reliable contraception were found to be protective factors for repeat TOPs whereas, parous women had higher risk for repeat TOPs. Information regarding repeat TOPs and factors influencing repeat TOPs should be included in sexual and reproductive health education in school health education. Proper counselling at the time of a TOP and the immediate initiation of reliable contraception should be significant in assisting women to avoid the need of subsequent TOPs. Provision of contraception among the youth by making it more accessible and available at low cost or free of charge is essential to reduce repeat TOPs.

## 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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