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Familial factors and child characteristics as predictors of injuries in toddlers: a prospective cohort study

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ABSTRACT

Objective: To identify family and child characteristics that put toddlers at risk of injuries.

Design: A prospective cohort study.

Setting: This study was based on the Norwegian Mother and Child Cohort Study, conducted by the Norwegian Institute of Public Health.

Participants: The study sample consisted of 26 087 children and their mothers.

Outcome measures: Family and child characteristics measured before or at 18 months of age were investigated as potential predictors of hospital-attended injuries that occurred between 18 and 36 months of age.

Results: In the multivariable analysis, younger maternal age (OR 0.93, 95% CI 0.86 to 1.00), financial problems (OR 1.18, 95% CI 1.01 to 1.39), maternal mental distress (OR 1.09, 95% CI 1.03 to 1.16), having older siblings (OR 1.22, 95% CI 1.08 to 1.39), increased gestational age at birth (OR 1.04, 95% CI 1.00 to 1.07) and male gender (OR 1.26, 95% CI 1.11 to 1.42) were risk factors for hospital-attended injuries. Children with impaired gross motor development had a decreased risk of injury (OR 0.65, 95% CI 0.42 to 0.99), whereas those with impaired fine motor development had an increased risk (OR 1.55, 95% CI 1.22 to 1.97). Shyness was a protective factor (OR 0.92, 95% CI 0.86 to 0.98). Children with three reported attention problems had a slightly increased risk of hospital-attended injuries (OR 1.33, 95% CI 1.02 to 1.72; p=0.035); otherwise, behaviour was not a significant risk factor.

Conclusions: This study demonstrated that a wide variety of factors were in play as predictors of injuries in young children. Both child-related factors (gender, gestational age at birth, child motor development, shyness and attention) and familial factors (having older siblings, maternal age, financial difficulties and maternal mental health problems) were associated with injuries in toddlers.

ARTICLE SUMMARY

Article focus

- To identify characteristics that put toddlers at risk of injuries in a large prospective cohort study.
- Several risk factors related to both the child's family situation and individual characteristics of the child have been identified, and this study assessed both important child factors and familial factors together.

Key messages

- This longitudinal population-based study of toddlers confirmed that a wide variety of factors are in play as predictors of injuries.
- Both child-related factors (gender, gestational age at birth, child motor development, shyness and attention) and familial factors (having older siblings, maternal age, financial difficulties and maternal mental health problems) were associated with injuries in toddlers.
- Children with impaired gross motor development had a decreased risk of injury, whereas those with impaired fine motor development had an increased risk; and the timing of preventive measures against injuries should be based on motor development in young children and not on age.

Strengths and limitations of this study

- The strengths of this study included its prospective design, large sample size and the inclusion of a large number of potentially important variables.
- A response rate of 42.7% suggests a selection bias, and comparisons with registry data have shown a positive selection into this cohort.
- This study's reliance on self-reported data may have affected the response accuracy, and there may be information biases.
- The use of abbreviated scales might have threatened the validity of measures.

INTRODUCTION

Injuries are a major cause of morbidity and mortality in toddlers.[1] The incidence of injury, mechanisms of trauma and type of injury vary with children's ages and developmental stages.[2 3] Before adolescence, the highest rate of injury occurs in toddlers aged 15–17 months.[2] Falls are consistently the leading cause of non-fatal injuries in toddlers, followed by poisoning and transportation-related

injuries.[2 3] Wounds and head injuries are the most common types of injury.[3]

Until the 1960s, injuries were considered accidental in the sense of being random acts of misfortune. Although they are still referred to as 'accidents', events that result in injuries are no longer regarded as unpredictable; rather, they are thought to have a causal sequence with identifiable risk factors.[4] Several studies have since reported that risk factors related to both the child's family situation and individual characteristics of the child are associated with injuries in children.

Low familial socioeconomic status[5–7] and related aspects, including low parental education, young maternal age, single motherhood, large family size, unemployment and substance abuse, are established risk factors for injuries in children.[6–8] More recently, researchers have found associations between the mother's mental health and an increased risk of injury in toddlers.[9 10] Adequate adult supervision is essential for toddlers to stay free from harm,[11–13] and mothers mental distress may reduce the ability to meet children's needs and may impact awareness of children's safety. Many unintentional injuries among young children are the results of inadequate supervision. Supervision exists on a spectrum from keeping a child overly protected and thereby denied opportunities to develop towards inadequate supervision and boundary setting exposing a child to avoidable harm.

Male sex is probably the best established risk factor for injury, and gender-specific behaviours such as rough play and taking risks are believed to contribute to this association in children.[14] Potentially important predictors that have received less attention in the literature include preterm birth and psychomotor development. Many studies have identified cognitive and behavioural consequences of preterm birth; however, few have examined these consequences in relation to the risk of later injury. Similarly, the relationship between psychomotor development and the risk of injury is not well established, as the few studies that have been conducted show conflicting results.[15–17] However, there is considerable individual variation in toddlers' motor development, and their physical development precedes their ability to understand the consequences of their actions. Motor ability may therefore be of specific importance as a risk factor for injuries in this age group.

Temperamental attributes in children have been associated with proneness to injury, including a high activity level, impulsiveness, sensation seeking and poor inhibitory control.[14] Each of these traits contributes to children's tendencies to place themselves in potentially dangerous situations. Externalising behaviours may also be challenging in toddlers and can affect child safety.[14 18] Attention problems may affect a child's ability to recognise potential environmental hazards and to comply with their supervisor's instructions and rules. Aggression and related high levels of oppositional behaviour make it difficult for parents to control their children and keep them safe from harm.[14 18–20]

The aim of this study was to assess important child factors and familial factors for injuries requiring hospital admission in toddlers. Research, mainly on older children, has identified a range of characteristics of children and several familial factors as risk factors for injuries in childhood, but few have assessed them together in young children. The Norwegian Mother and Child Cohort Study (MoBa), with its comprehensive data collection over several waves, offered a unique opportunity to assess these relationships prospectively in a large-scale population-based study.

METHODS

Design and participants

This study used data from the MoBa, conducted by the Norwegian Institute of Public Health. MoBa is a prospective, population-based pregnancy cohort study with a target population of all pregnant women in Norway and their children. The women were recruited to the study at approximately week 17 of gestation through postal invitations prior to routine ultrasound examinations at their local hospitals. The study included 108 000 pregnancies; recruitment began in 1999 and was completed in 2008. The response rate was 42.7%.[21] Questionnaire data were collected at gestational weeks 17 and 30 and at an age of 6, 18 and 36 months of the child. Information from the Medical Birth Registry of Norway (MBRN) was also available (http://www.fhi.no/mfr). Informed consent was obtained from each participant upon recruitment. The Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate approved the study. Details of the MoBa study's sampling, design, questionnaires, informed consent processes and data collection strategies have been reported elsewhere (http://www.fhi.no/morogbarn).[21]

Although recruitment to the study is complete, data collection is an ongoing process. The current study is based on data files released for research on February 2009. This file comprised the first 27 227 children and their mothers who had completed the questionnaires when their children were aged 36 months. Cases with missing data on hospital-attended injuries in the children were excluded (N=1140), and the study sample comprised 26 087 children and mothers.

Injuries

At 36 months of age, injuries in toddlers were assessed using the following questions: 'Has your child suffered any injury or accident since the age of 18 months?' and 'If yes, has the child been admitted to or examined in hospital?' The response categories to both items were 'yes' or 'no'. The outcome variable in our study was an affirmative answer for hospital-attended injuries.

Familial factors

Demographic information regarding older siblings, maternal age, maternal education and occupational status was reported at gestational week 17. At child's age

of 18 months, whether the mother and child lived with the child's father was assessed with the following question: 'Do you and your child live with your child's father?' Current financial problems were assessed with the following questions: 'Have you had financial problems since the previous questionnaire?' The response categories were 'yes' or 'no'. Data on ethnicity were not available at the individual level in this study; however, the MoBa cohort comprised predominantly ethnic Norwegian and Scandinavian families (95%).

Maternal mental health

The mother's mental health was assessed with the Symptom Checklist SCL-8 when the child was aged 18 months.[22 23] The SCL-8 is designed to measure psychological distress, particularly anxiety and depression, in population surveys. Each item has four response categories, ranging from 'not at all'=1 to 'severe'=4.[24] Cronbach's α was 0.84.

Child factors

Information regarding the child's sex, birth weight and gestational age was retrieved from the MBRN. Births before gestational age of 37 weeks were classified as preterm births.

Child development

Development was assessed using items derived from the Norwegian version of the Ages and Stages Questionnaire (ASQ). The ASQ was designed for first-level screening and to monitor developmental delay in children.[25] When the child was aged 18 months, development was assessed using three items from the gross motor area (Cronbach's α=0.63), three items from the fine motor area (Cronbach's α=0.30), three items from the communication area (Cronbach's α=0.59) and four items from the personal–social area (Cronbach's α=0.50) of the ASQ 18 months form. Due to poor internal consistency, these measures were analysed as categorical variables. The choice of responses was 'not yet', 'sometimes' or 'yes'. Responses of 'not yet' and 'sometimes' are indicative of delayed development and were categorised jointly as 'not yet'. The number of developmental skills that were not achieved was summarised, and the following three categories were formed: 'all skills achieved', 'one skill not achieved' and 'two or more skills not achieved'.

Child temperament

The Emotionality, Activity, Shyness and Sociability Temperament Survey for Children[26] was used to assess temperament at 18 months of age. Three items from each of the emotionality, activity and shyness subscales were included. 'Emotionality' refers to the tendency to become easily and intensely aroused or upset. 'Activity' refers to the preferred level of activity and speed of action. 'Shyness' refers to the tendency to be inhibited and awkward in new social situations. Each item was rated using a 5-point scale, ranging from 'not typical'=1 to 'very typical'=5. Cronbach's α was 0.64 for emotionality, 0.64 for activity and 0.65 for shyness.

Child behaviour

Child externalising behaviour was assessed using items from the Child Behaviour Checklist for ages 1.5–5 years[27] when the child was aged 18 months. Five items assessing aggressiveness and three items assessing attention problems were available. Cronbach's α was 0.44 for the aggressive subscale and 0.59 for the attention subscale. Due to poor internal consistency, these measures were analysed as categorical variables. All items were rated 'not true', 'somewhat or sometimes true' and 'very true or often true'. 'Somewhat or sometimes true' and 'very true or often true' were categorised together to indicate problem behaviours. The number of problems was summarised and then categorised as 'no problems', one, two or three problems for the attention subscale and one, two or three or more problems for the aggressiveness subscale.

Statistical analysis

Predictors of hospital-attended injuries in children were analysed using logistic regression with a Generalised Estimating Equation approach to account for correlation due to the inclusion of siblings in the study sample. Associations are presented as crude ORs and adjusted ORs with 95% CIs. The corresponding tests for significance were performed using the Wald test statistic and a significance level of $p<0.05$. The sum scores of independent continuous measures were standardised, and the presented ORs represent the difference in risk for an increase of 1SD. Measures with internal consistency of Cronbach's $\alpha<0.60$ were categorised. Variance inflation factors were computed to assess multicollinearity. The model was cross-validated in two randomly selected subsamples. Stratification by gender produced only minor differences in effect estimates of potential risk factors. The rate of missing information ranged from 0% to 11.9%. Modelling was based on 20 multiply imputed data sets. Multivariate Imputation by Chained Equations was used for imputations.

All analyses were performed using R (The R Foundation for Statistical Computing, Vienna, Austria), with the R packages gee for logistic regression using Generalised Estimating Equation and Multivariate Imputation by Chained Equations for multiple imputation.

RESULTS

The study sample comprised 50.7% males, with 53% of the children having older siblings. The mean gestational age at birth was 39.4 weeks (SD=2.0). Maternal age ranged from 14 to 47 years, with a mean of 29.7 years (SD=4.4). The majority of mothers (60.5%) had more than 12 years of education. Only 0.9% of the subjects (N=252) were teenage mothers, and 3.4% (N=853) reported not living with the father of their child. Four per cent of mothers were unemployed or disabled. Current financial problems were reported by 18.5% of

mothers. A hospital-attended injury between 18 and 36 months of age was reported for 4.6% (N=1247) of the children.

Table 1 displays univariable and multivariable comparisons between children with and without hospital-attended injuries. In unadjusted analyses, a range of factors were significantly associated with injuries, including maternal mental distress, financial problems, gender, gestational age at birth, development, temperament and behaviour. Children born preterm had a decreased risk of injury (OR=0.74, 95% CI 0.56 to 0.96; p=0.024).

Similarly, several potential predictors were significantly associated with hospital-attended injuries in toddlers in the multivariable analyses.

Familial factors

In the adjusted model, financial problems, maternal mental distress and having older siblings were risk factors for hospital-attended injuries in toddlers. Older maternal age was a protective factor. Maternal education, occupational status and not living with the child's father were not associated with hospital-attended injuries.

Child factors

Male gender and increased gestational age at birth were risk factors for hospital-attended injuries in the toddlers. Children with impaired gross motor development were less prone to injury, whereas children with less fine motor skills were more at risk. Social development was not significantly associated with hospital-attended injuries. Impaired communication, the temperamental traits of emotionality and activity and aggressive behaviour did not achieve statistical significance in the adjusted analysis. Following adjustment, shyness remained a protective factor and children with at least three reported attention problems had a modestly increased risk for hospital-attended injuries (p=0.035).

DISCUSSION

Injuries in toddlers are multifaceted phenomena with a wide variety of relevant risk factors in play. The current population-based study of toddlers found that both familial factors and developmental factors in children were associated with injury risk. Consistent with previous studies and our clinical experience, children admitted to hospitals with injuries are not randomly selected.

Similar to earlier studies,[8] having older siblings was a risk factor for hospital-attended injuries. Differences in parental supervision or the possibility that older siblings sometimes act as supervisors may explain this association. Older siblings may also act as models of risky behaviour. Research has shown that children are allowed to engage in more risky behaviour and show poor compliance when supervised by their older siblings rather than by their mothers.[28]

Education and socioeconomic status are closely intertwined, and most prior studies have found that low maternal education is a risk factor for injuries in children. In this study, maternal education, unemployment and single parenthood were not associated with injury. This lack of association may be due to the generally high educational level, well-developed social security system and high standard of living in Norway. Financial problems, which were significantly associated with injury, were reported by a rather large proportion of the mothers in this study and are not likely to represent poverty, but perhaps problems to adapt to a life situation with a growing family. As in other studies, older maternal age was a protective factor.[6 7]

In line with previous research, maternal mental health problems constituted a risk factor for injuries in children.[9 10] Mental distress may reduce a parent's attention to external cues and may negatively impact the parent–child relationship. Maternal mental distress withstood adjustment for other familial and child-related predictors. This observation calls for further investigation of the mechanisms involved.

Behavioural and temperamental differences between boys and girls have been proposed as explanations for the well-established relationship between gender and injury risk. In this study, adjustment for development, temperament and behaviour did barely attenuate this relationship. Perhaps other differences, for example, gender-specific socialisation, supervision and guidance, games and encouraged activities, might explain this disparity.

Our finding that the risk of injury was increased with increasing gestational age at birth and that preterm birth was associated with a decreased risk was unanticipated. Many studies have identified later behavioural problems, including attention deficit and hyperactivity in children who are born preterm,[29] attributes that are also linked to injury proneness. On the other hand, studies of adolescents have suggested that children born at extremely low birth weight are more cautious, shy and risk aversive than their normal birth weight counterparts,[30] and our finding might be explained by such attributes. More research is needed to confirm and explain this finding.

Novel findings in this study were that children with impaired gross motor development had a decreased risk for injury, whereas those with impaired fine motor development had an increased risk. Toddlers' physical development often precedes their ability to understand the consequences of their actions, and early physical mobility may put children at greater risk of injury, regardless of their temperament, behaviour or environment. Impaired fine motor development may be linked to clumsiness, which subsequently leads to injury proneness. Alternatively, early fine motor development may reflect a preference for calmer activities. The different directionalities of the associations between gross and fine motor development and injury risk imply that these areas should be assessed separately in future studies.

Table 1 Descriptive comparison between children with and without hospital-attended injuries and univariable and multivariable logistic regression analysis of potential risk factors (N=26 087)

	Overall (N=26 087) % (N)/mean (SD)	Without injuries % (N)/mean (SD)	With injuries % (N)/mean (SD)	OR (95% CI)	aOR (95% CI)
Family factors					
Older sibling(s)	53.3 (13 902)	53.1 (13 197)	56.5 (705)	1.15 (1.02 to 1.29)*	1.22 (1.08 to 1.39)**
Maternal age	29.7 (4.43)	29.7 (4.44)	29.5 (4.44)	0.95 (0.89 to 1.02)	0.93 (0.86 to 1.00)*
Maternal education ≤12 years	37.6 (9534)	37.6 (9078)	37.6 (456)	0.99 (0.88 to 1.12)	0.90 (0.80 to 1.02)
Mother unemployed or disabled	4.1 (1069)	4.1 (1017)	4.2 (52)	1.01 (0.76 to 1.36)	0.95 (0.71 to 1.26)
Mother and child not living with the father	3.4 (819)	3.4 (778)	3.6 (41)	1.06 (0.77 to 1.46)	0.96 (0.69 to 1.33)
Financial problems	18.6 (4379)	18.4 (4129)	22.4 (250)	1.27 (1.09 to 1.48)**	1.18 (1.01 to 1.39)*
Maternal mental health problems (8-32)	10.2 (2.84)	10.1 (2.82)	10.5 (3.06)	1.12 (1.06 to 1.18)***	1.09 (1.03 to 1.16)**
Child factors					
Male	50.8 (13 250)	50.5 (12 540)	56.9 (710)	1.30 (1.16 to 1.45)***	1.26 (1.11 to 1.42)***
Gestational age	39.4 (1.94)	39.4 (1.96)	39.5 (1.79)	1.04 (1.01 to 1.07)*	1.04 (1.00 to 1.07)*
Gross motor development					
All skills achieved	82.2 (19 742)	82.1 (18 794)	83.8 (948)	Reference	Reference
One skill not achieved	14.5 (3481)	14.5 (3322)	14.1 (159)	0.94 (0.80 to 1.12)	0.94 (0.79 to 1.12)
Two or three skills not achieved	3.4 (800)	3.4 (776)	2.1 (24)	0.65 (0.43 to 0.98)*	0.65 (0.42 to 0.99)*
Fine motor development					
All skills achieved	73.8 (17 569)	73.9 (16 754)	72.3 (815)	Reference	Reference
One skill not achieved	21.0 (5004)	21.0 (4774)	20.4 (230)	1.01 (0.87 to 1.18)	1.03 (0.89 to 1.19)
Two or three skills not achieved	5.2 (1236)	5.1 (1154)	7.3 (82)	1.45 (1.15 to 1.83)**	1.55 (1.22 to 1.97)***
Communication development					
All skills achieved	46.6 (11 117)	46.8 (10 631)	43.1 (486)	Reference	Reference
One skill not achieved	26.5 (6313)	26.4 (5989)	28.7 (324)	1.16 (1.00 to 1.34)*	1.11 (0.95 to 1.28)
Two or three skills not achieved	26.9 (6413)	18.3 (6095)	19.3 (318)	1.13 (0.98 to 1.31)	1.04 (0.89 to 1.22)
Social development					
All skills achieved	71.3 (17 094)	71.4 (16 302)	70.3 (792)	Reference	Reference
One skill not achieved	19.6 (4688)	19.5 (4451)	21.0 (237)	1.09 (0.94 to 1.27)	1.04 (0.90 to 1.21)
Two or more skill not achieved	6.6 (1582)	6.6 (1510)	6.4 (72)	0.99 (0.77 to 1.26)	0.92 (0.73 to 1.15)
Temperament					
Activity (3–15)	12.1 (1.96)	12.1 (1.96)	12.2 (1.97)	1.09 (1.02 to 1.16)**	1.02 (0.95 to 1.09)
Emotionality (3–15)	8.2 (2.27)	8.2 (2.26)	8.3 (2.37)	1.06 (0.99 to 1.12)	1.02 (0.96 to 1.09)
Shyness (3–15)	6.1 (1.93)	6.1 (1.93)	6.0 (1.95)	0.92 (0.87 to 0.98)**	0.92 (0.86 to 0.98)*
Externalising behaviour					
Attention					
No attention problem	10.7 (2464)	10.8 (2371)	8.7 (93)	Reference	Reference
One attention problem	41.9 (9653)	42.1 (9231)	39.3 (422)	1.15 (0.91 to 1.44)	1.13 (0.89 to 1.43)
Two attention problems	28.7 (6611)	28.7 (6288)	30.0 (323)	1.26 (1.00 to 1.60)	1.19 (0.93 to 1.53)
Three attention problems	18.7 (4294)	18.5 (4057)	22.0 (237)	1.47 (1.16 to 1.86)**	1.33 (1.02 to 1.72)*

Continued

Table 1 Continued

	Overall (N = 26 087) % (N)/mean (SD)	Without injuries % (N)/mean (SD)	With injuries % (N)/mean (SD)	OR (95% CI)	aOR (95% CI)
Aggression					
No aggression problem	14.6 (3278)	14.6 (3151)	12.1 (127)	Reference	Reference
One aggression problem	22.8 (5953)	26.3 (5685)	25.5 (268)	1.13 (0.92 to 1.38)	1.07 (0.87 to 1.31)
Two aggression problems	24.3 (6332)	27.9 (6018)	29.8 (314)	1.21 (0.99 to 1.47)	1.09 (0.89 to 1.34)
Three or more aggression problems	27.2 (7091)	31.2 (6747)	32.7 (344)	1.21 (1.00 to 1.47)	1.01 (0.82 to 1.25)

*p<0.05, **p<0.01, ***p<0.001 from Wald test statistic.
aOR, adjusted OR.

Shyness was a consistent protective factor against injury. Shyness is considered to be an inhibition to the unfamiliar and is associated with inhibitory control.[31 32] The protective effect of shyness observed in this study indicates that inhibitory control may also be a protective factor against injury in young children. Attention problems was borderline significant after adjustment and may be a risk factor for injuries in toddlers. Aggression was not significant. These findings are different from the many studies of older children concluding with behaviour as a predictor for injuries.[14 18–20] This disparity may be due to measurement difficulties at this early age or lack of stability in aggressive behaviour in the developmental period in this study (18 and 36 months). In our study, the associations between temperament and behaviour, and injury were substantially attenuated following adjustment, perhaps indicating that other factors may be more robust predictors of injuries in young children.

There are some important limitations of this study. A response rate of 42.7% suggests a selection bias, and comparisons with data from MBRN have shown a positive selection into this cohort,[21 33] and the study sample can be regarded as a low-risk population; this fact may have resulted in an underestimation of the true effect sizes. However, few significant differences in exposure–outcome associations have been identified in studies of this cohort,[33] and the positive associations found in this study is likely to be generalisable.

This study's reliance on self-reported data may have affected the response accuracy. Self-reported medically attended or hospital-attended injuries are common measures in the injury literature. However, injury recall has been shown to decrease with time and tends to be more accurate for major injuries.[34 35] The expected over-representation of more recent injuries and more severe injuries will, however, not affect the association measures. The division into children with and without hospital-attended injuries leaves children with injuries treated in outpatient clinics in the comparison group and may have led to an underestimation of effects. There may also be selection biases regarding injury severity and type of injuries, which are treated in outpatient clinics. Especially, regional differences with more severe injuries treated in outpatient clinics in rural areas are expected. Our study did not include systematic measures of injury severity, injury mechanism or injury type. Another omitted variable in this study was adult supervision, which is an important factor in preventing injuries in preschool children. This study was also unable to discriminate injuries that resulted from abuse.

The sample predominantly comprised ethnic Norwegian participants and did not allow us to investigate the influence of ethnicity or culture. As in other large population studies, there was extensive use of abbreviated scales that might threaten the validity of measures. The strengths of this study included its prospective design, large sample size and the inclusion of a large number of potentially important variables.

An injury brings the family in contact with healthcare and gives professionals an opportunity to identify potential risk factors. In addition, the fact that injuries may also be caused by poor supervision and, sometimes, neglect or abuse emphasise that a thorough assessment of the circumstances surrounding injuries in young children is important to identify families where children are at risk of further injury.

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Contributors MCM cleaned and analysed the data and drafted and revised the paper. ST, JBG and GD contributed to the interpretation of the data and critical revisions of the manuscript. All authors have studied the manuscript in the form submitted and have accepted the order of authorship.

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Competing interests None.

Patient consent This study was based on data from the Norwegian Mother and Child Cohort Study, conducted by the Norwegian Institute of Public Health. The current study did not use a separate consent form.

Ethics approval The Norwegian Data Inspectorate (ref nr 01/4325) and the Regional Committee for Medical Research Ethics (ref nr S-97045 and S-95113). The current study used only anonymous data and did not require separate approval.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement This study was based on the Norwegian Mother and Child Cohort Study, conducted by the Norwegian Institute of Public Health (NIPH). Researchers who want to access data or other biological material from health registers, biobanks and projects administered by the NIPH must apply according to defined rules, submitting the appropriate application form together with licences and approval as needed. All applications should be send to dataaccess@fhi.no

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