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## **Hospitalisation in adolescence affects the likelihood of giving birth:**

### **A Swedish population-based register study**

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**Key words:** Adolescent; Birth Rate; Cohort Studies; Female; Morbidity.

## **ABSTRACT**

**Aim:** To examine the effect of hospitalisation during adolescence on the likelihood of giving birth. **Methods:** 142,998 women born in 1973-75 were followed with the help of the Swedish Medical Birth Register and the Swedish Total Population Register up until the end of 2000 with respect to their likelihood of giving birth. **Results:** The likelihood of giving birth between 20 and 27 years of age was positively affected by hospitalisation at least once during adolescence according to the Swedish Hospital Discharge Register; adjusted hazard ratio = 1.32, 95% confidence interval: 1.29-1.35. Women hospitalised due to genitourinary diseases, respiratory diseases, abdominal problems, and abuse of alcohol and drugs were more likely to have given birth during the study period, while hospitalisations according to cerebral palsy and congenital malformations tended to decrease childbearing. Women hospitalised due to psychiatric diseases had an increase likelihood of given birth at 20-24 years but a reduced thereafter. **Conclusions:** A majority of the causes of hospitalisation during adolescence increased the likelihood of giving birth between ages 20 to 27, even after adjustments for socio-economic characteristics and factors related to the studied women's own birth.

## **INTRODUCTION**

The relation between adolescent morbidity and future reproductive performance has sparsely been addressed, although adolescence is a complex period within human growth [1,2].

Previous studies suggest a reduction in childbearing following several kinds of morbidity during childhood. Women with congenital anomalies [3], survivors of childhood cancer [4], and women with epilepsy [5] seem to be less likely to have children. Sexually transmitted infection (STI) rates are higher in adolescents compared to adults, which may also have a negative effect on future fertility [1,6,7]. Psychosocial factors may influence the relation between adolescent morbidity and later childbearing. Adolescent-onset psychiatric disorders seem to be associated with increased probability of teenage pregnancy [8]. Adolescents with chronic illness report higher body dissatisfaction, but similar or higher rates of sexual intercourse and unsafe sex, compared to healthy controls [9,10]. Most previous studies have studied the effect of specific diagnoses or conditions on future fertility or childbearing and the focus has mainly been on childhood morbidity.

Swedish population-based registries offer an opportunity to study the effect of all causes of hospitalisation during adolescence on the timing of first birth in a large cohort of women. The aim of the present study was, thus, to examine the effect of hospitalisations during adolescence on the likelihood of giving birth between 20 and 27 years of age among women by studying diagnose groups (i.e. ICD-chapters) as well as specific diagnoses. The aim was not to study teenage pregnancies or births. We have previously found that non-optimal birth-characteristics such as being born small for gestational age (SGA) or preterm are connected to higher risks of adolescent hospitalisations but also to later childbearing [11,12], and several studies have found that socio-economic characteristics influence the timing of first birth

and/or the reproductive function in women [6,12-14]. Therefore we retrieved information on socio-economic characteristics as well as birth-characteristics to include in the analyses.

## **MATERIALS AND METHODS**

The women were identified by means of the Swedish Medical Birth Register (MBR) [15] and the Total Population Register (TPR) [16]. The MBR, established in 1973, contains information on birth-related variables and the previous reproductive history of the mother while the TPR includes information on births, deaths, marital status, emigration history, and country of origin for Swedish residents born abroad. The Swedish Hospital Discharge Register (HDR) covers all public in-patient care in Sweden since 1987 [17]. The diagnoses in the HDR are based on the Swedish version of the World Health Organization's international classification of diseases (ICD), and between 1987 and 1996 the 9<sup>th</sup> revision (ICD-9) was used [18]. Other registries used were the Causes of Death Register which records information on all deceased persons registered in the country [19], and the Multi-Generation Register [20] which makes it possible to identify the fathers of the children registered in the MBR and TPR. Information on the educational level of the study population and their parents was retrieved from the Education Register [21] and the 1970 Population and Housing Census [22].

All women born in 1973, 1974, and 1975 according to the MBR and the TPR, alive and still living in Sweden at 13 years of age, served as the original study population ( $n = 150,425$ ).

Information available in the other registries was retrieved by use of the infant's or mother's unique personal identification number. Women with missing values on birth weight and/or gestational length were excluded ( $n = 1,029$ ), as were 126 women with extremely high birth weights compared to their length of gestation i.e. obvious erroneous values, as described earlier[12]. In addition, 1,003 women were excluded because their parents could not be

identified in the registries and 5,293 women because they emigrated, died, or gave birth before 20 years of age. The final cohort consisted of 142,988 women living in Sweden at 20 years of age, followed-up between 20 and 27 years of age.

Hospitalisations during adolescence (i.e. between 13 and 19 years of age) was defined as a dichotomy, i.e. 'hospitalised one or more times' and 'not hospitalised'. For women born in 1973 the hospitalisation period studied was 14 to 19 years of age, since the HDR did not have complete coverage in 1986 when these women were 13 years old. The diagnoses listed in the ICD-9 are categorised in 17 ICD-chapters. Each chapter includes a range of more specific diagnoses. All main diagnoses of hospitalisation, except those related to the ICD-chapters 'complications of pregnancy, childbirth, and puerperium' and 'certain conditions originating in the perinatal period', were included in the analyses.

Included parental socio-economic characteristics were the mothers' and fathers' educational levels in 1970, the parents' country of origin, and the mothers' marital status, parity, and age at the time of giving birth (i.e. in 1973-75). The educational levels were coded according to the Swedish educational system: 'elementary school' (9 or 10 years), 'high school' (11-13 years), and 'graduate and postgraduate education' (14 years or more). The parents' country of origin was coded to indicate if at least one of them had been born outside the Nordic countries or if both had been born in the Nordic countries. The marital status of the mothers was coded as 'married', 'unmarried', and 'divorced or widowed'. The mother's parity at the time of giving birth was split into two categories: 'no previous children' and 'one or more previous children', and their age into four categories:  $\leq 19$ , 20-26, 27-33, and  $\geq 34$  years. The year of birth of the women studied (i.e. 1973, 1974, and 1975), 'twin birth' (yes/no), and whether the women were born preterm or SGA were also included as background characteristics. Preterm birth was defined as less than 37 completed weeks of gestation and SGA as a birth weight less

than two standard deviations below the mean weight for the gestational length according to the Swedish standard [23]. As the number of missing values on parental education was relatively large and the parents with missing data tended to be younger and born outside the Nordic countries to a greater extent [12,24], the groups for which values were missing were added as separate categories in the analyses. Missing values for other variables (< 1% on each variable) were assigned to the largest category on each variable.

### **Statistical analyses**

The Cox's proportional hazards model was used to evaluate the effect of hospitalisation on the likelihood of giving birth between 20 and 27 years of age. The time-variable was defined as age and the women exited from risk when they gave birth to the first child, emigrated for the first time, died, or reached the end of follow-up. Of the women, 3.8% emigrated and 0.2% died during the period of study. The hazard ratios (HR) and 95% confidence intervals adjusted for parental socio-economic characteristics and birth-related variables were calculated. The effect of hospitalisation according to the 15 ICD-chapters studied was evaluated by analysing each ICD-chapter as a separate model as well as by simultaneously including hospitalisations according to all ICD-chapters in one model (Table 1). In order to evaluate the relations in more detail we also studied the five most commonly occurring main diagnoses on the three-digit level within each ICD-chapter. This produced 15 separate models (one for each ICD-chapter), and, due to the relatively large number of statistical tests, the significance level was set to  $p \leq 0.01$ .

The possible age-dependence of the associations were checked by stratifying the analyses according to the women's age at giving birth into two strata: 20-24 years and 25-27 years.

**Table 1.** Likelihood of giving birth between 20 and 27 years of age in relation to hospitalisations during adolescence.

Main cause of hospitalisation during adolescence (ICD-9 chapter)	No. giving birth among exposed <sup>a</sup>	Relative rate of giving birth					
		Each ICD-chapter analysed separately			All ICD-chapters included in the same model		
		HR <sup>b</sup>	95% CI	<i>p</i> value	HR <sup>b</sup>	95% CI	<i>p</i> value
Infections and parasitic diseases	629	1.26	1.16-1.36	< 0.001	1.14	1.05-1.23	0.002
Neoplasm	176	0.96	0.82-1.11	0.55	0.88	0.76-1.02	0.098
Endocrine, nutritional, and metabolic diseases	231	1.00	0.88-1.14	0.97	0.92	0.81-1.05	0.22
Blood diseases and immunity disorders	267	1.60	1.42-1.80	< 0.001	1.40	1.24-1.58	< 0.001
Mental disorders	735	1.35	1.25-1.45	< 0.001	1.20	1.11-1.29	< 0.001
Diseases of the nervous system	457	1.04	0.95-1.14	0.38	0.97	0.88-1.06	0.46
Diseases of the circulatory system	124	1.21	1.02-1.45	0.032	1.09	0.91-1.30	0.35
Diseases of the respiratory system	1720	1.32	1.26-1.38	< 0.001	1.24	1.19-1.31	< 0.001
Diseases of the digestive system	1358	1.24	1.18-1.31	< 0.001	1.15	1.08-1.21	< 0.001
Diseases of the genitourinary system	1281	1.66	1.57-1.76	< 0.001	1.51	1.43-1.60	< 0.001
Diseases of the skin and subcutaneous tissue	201	1.26	1.10-1.45	0.001	1.15	1.00-1.32	0.056
Diseases of the musculoskeletal system and connective tissue	770	1.21	1.12-1.30	< 0.001	1.13	1.05-1.22	0.001
Congenital anomalies	265	0.94	0.84-1.06	0.34	0.89	0.79-1.00	0.052
Symptoms, signs, and ill-defined conditions	2577	1.54	1.48-1.60	< 0.001	1.41	1.36-1.47	< 0.001
Injury, poisoning, and other external causes	2393	1.24	1.19-1.29	< 0.001	1.16	1.11-1.21	< 0.001

<sup>a</sup> Number of women giving birth between 20 and 27 years of age who were hospitalised one or more times during adolescence according to each ICD-chapter. Note that a woman may have been hospitalised according to diagnoses listed in more than one ICD-chapter.

<sup>b</sup> Cox proportional hazards model adjusted for the mother's and father's educational levels, parents' country of origin, mother's marital status, and mother's age and parity, as well as for the year of birth of the women and if the women were born as a result of twin birth or born preterm or SGA.

### *Ethical consideration*

The present study was approved by the Human Research Ethics Committee; Faculty of Health Sciences, Linköping University, Sweden.

## **RESULTS**

Among the women, 22.1% were hospitalised once or more during adolescence. The most common causes were diagnoses related to ‘symptoms, signs, and ill-defined conditions’, and ‘injury, poisoning, and other external causes’ (data not shown). The women’s likelihood of giving birth between 20 and 27 years of age was 28.8%, adjusted for mortality and emigration. Women who were hospitalised according to a diagnosis in at least one ICD-chapter were more likely to have given birth. This relation was evident even after adjustments for parental socio-economic characteristics and factors related to the studied women’s own birth, HR: 1.32 (95% CI: 1.29 to 1.35),  $p < 0.001$ . Evidence of positive connections were found for diagnoses related to 11 out of 15 ICD-chapters, and the effects were substantially the same when analysing each ICD-chapter category in separate models versus analysing all ICD-chapters in one model (Table 1).

Women hospitalised due to ‘diseases of the genitourinary system’ seemed to be the most likely to have given birth (Table 1). All five most commonly occurring three-digit level diagnoses in this ICD-chapter were positively related to the outcome (Table 2). Women hospitalised due to the diagnosis ‘other diseases due to viruses and chlamydia’ in the ICD-chapter ‘infections and parasitic diseases’ also had a higher likelihood of giving birth (Table 2). In addition, hospitalisations due to abdominal problems in the ICD-chapters ‘diseases of the digestive system’ and ‘symptoms, signs, and ill-defined conditions’, respectively, were positively related to outcome studied (Tables 1 and 2).

**Table 2.** Likelihood of giving birth between 20 and 27 years of age in relation to hospitalisations during adolescence according to the five most common three-digit level diagnoses in each ICD-chapter<sup>a</sup>.

ICD-9 chapter	Diagnoses (ICD-code)	No. giving birth among exposed <sup>b</sup>	HR <sup>c</sup>	95% CI
<b>Infections and parasitic diseases</b>	Streptococcal sore throat and scarlatina (034)	45	1.50	1.12-2.01
	Other diseases due to viruses and chlamydiae (078)	57	1.95	1.50-2.52
<b>Blood diseases and immunity disorders</b>	Other diseases of blood and blood-forming organs (289)	244	1.87	1.65-2.12
<b>Mental disorders</b>	Nondependent abuse of drugs (305)	196	1.50	1.30-1.72
	Disturbance of emotions specific to childhood and adolescence (313)	155	1.44	1.23-1.69
	Adjustment reaction (309)	109	1.48	1.22-1.79
	Neurotic disorders (300)	75	1.58	1.26-1.98
<b>Diseases of the nervous system</b>	Migraine (346)	48	1.45	1.10-1.93
	Infantile cerebral palsy (343)	5	0.19	0.08-0.45
<b>Diseases of the respiratory system</b>	Chronic diseases of tonsils and adenoids (474)	1050	1.35	1.27-1.44
	Asthma (493)	177	1.49	1.29-1.73
	Acute tonsillitis (463)	142	1.42	1.21-1.68
<b>Diseases of the digestive system</b>	Acute appendicitis (540)	826	1.20	1.12-1.28
	Functional digestive disorders, not elsewhere classified (564)	56	1.88	1.45-2.45
<b>Diseases of the genitourinary system</b>	Other disorders of breast (611)	245	1.24	1.09-1.41
	Inflammatory disease of ovary, fallopian tube, pelvic cellular tissue and peritoneum (614)	255	1.97	1.74-2.23
	Non-inflammatory disorders of ovary, fallopian tube and broad ligament (620)	196	1.62	1.40-1.86
	Infections of kidney (590)	164	1.61	1.38-1.88
	Pain and other symptoms associated with female genital organs (625)	145	1.88	1.59-2.22
<b>Diseases of the skin and subcutaneous tissue</b>	Pilonidal cyst (685)	54	1.64	1.25-2.14
<b>Diseases of the musculo- skeletal system and connective tissue</b>	Other derangement of joint (718)	98	1.48	1.21-1.80
	Other and unspecified disorder of joint (719)	72	1.63	1.29-2.05
<b>Symptoms, signs, and ill-defined conditions</b>	Other symptoms involving abdomen and pelvis (789)	2146	1.61	1.54-1.68
<b>Injury, poisoning, and other external causes</b>	Concussion (850)	754	1.28	1.19-1.37
	Poisoning by analgesics, antipyretics, and anti-rheumatics (965)	226	1.79	1.57-2.04
	Toxic effect of alcohol (980)	109	1.58	1.31-1.91

<sup>a</sup> Only relations with  $p \leq 0.01$  are presented in the table.

<sup>b</sup> Number of women giving birth between 20 and 27 years of age who were hospitalised one or more times during adolescence according to each diagnosis, respectively.

<sup>c</sup> Cox proportional hazards model adjusted for the mother's and father's educational levels, parents' country of origin, mother's marital status, and mother's age and parity, as well as for the year of birth of the women and if the women were born as a result of twin birth or born preterm or SGA.

Hospitalisations due to ‘mental disorders’ or ‘injury, poisoning, and other external causes’ were also positively related to the likelihood of giving birth at age 20-27 (Table 1). The three-digit level diagnoses with the highest hazard ratios within each chapter were ‘neurotic disorders’ and ‘poisoning by analgesics, antipyretics, and anti-rheumatics’ (Table 2). In addition, higher likelihood of giving birth was found for diagnoses related to other ICD-chapters, such as ‘diseases of the respiratory system’ and ‘diseases of the musculoskeletal system and connective tissue’ (Table 1 and 2). There was indication of a reduced likelihood of giving birth between 20 and 27 years of age among women who were hospitalised due to ‘congenital anomalies’ during adolescence on the ICD-chapter level (Table 1). Although there was little association with ‘diseases of the nervous system’ in general (Table 1) the detailed analyses indicated that women who had been hospitalised due to ‘infantile cerebral palsy’ had a lower likelihood of giving birth, while women hospitalised with ‘migraine’ had a higher likelihood (Table 2).

For some diagnoses there was evidence of the hazard ratios decreasing by age (Table 3). The most marked negative trend was found for diagnoses related to ‘mental disorders’. Women who were hospitalised according to ‘mental disorders’ had an increased likelihood of giving birth between 20 and 24 years of age, but a reduced between 25 and 27 years of age.

## **DISCUSSION**

Most causes of hospitalisation during adolescence increased the likelihood of giving birth at ages 20 to 27, among Swedish women born 1973-75, even after adjustments for socio-economic background variables and variables related to the studied women’s own birth.

A major strength in this study is that the results are based on a large population-based cohort with prospectively collected register data. Through the registries, we were able to get information on certain factors related to the studied women’s own birth as well as socio-

**Table 3.** Likelihood of giving birth between 20 and 27 years of age in relation to hospitalisations during adolescence. Analyses stratified by age group<sup>a</sup>.

ICD-9 chapter	Age 20-24 years <sup>b</sup>		Age 25-27 years <sup>b</sup>		<i>p</i> value <sup>c</sup>
	HR	95% CI	HR	95% CI	
Mental disorders	1.64	1.51-1.78	0.82	0.70-0.95	< 0.001
Diseases of the nervous system	1.14	1.02-1.27	0.87	0.74-1.03	0.008
Diseases of the respiratory system	1.41	1.33-1.49	1.15	1.06-1.26	< 0.001
Diseases of the digestive system	1.34	1.25-1.43	1.08	0.98-1.19	< 0.001
Diseases of the genitourinary system	1.80	1.69-1.93	1.40	1.26-1.55	< 0.001
Symptoms, signs, and ill-defined conditions	1.71	1.63-1.79	1.22	1.13-1.32	< 0.001
Injury, poisoning, and other external causes	1.34	1.27-1.41	1.07	0.99-1.15	< 0.001

<sup>a</sup> Only ICD-chapters with significant differences in hazard ratios between age groups are presented.

<sup>b</sup> Cox proportional hazards model adjusted for the mother's and father's educational levels, parents' country of origin, mother's marital status, and mother's age and parity, as well as for the year of birth of the women and if the women were born as a result of twin birth or born preterm or SGA.

<sup>c</sup> *p*-value for difference in hazards ratio between age groups.

economic characteristics in childhood, of importance when studying the effect of hospitalisations during adolescence on the timing of first birth [11-14]. The present study is also one of the first investigating this effect in a 'broad perspective'.

The outcome studied was the likelihood of giving birth, not pregnancy, and as the main exposure studied was hospitalisation during adolescence, teenage pregnancies were not included. Teenage deliveries are relatively uncommon in Sweden (about 2% in the year 2000 [25]). Figures on abortions (spontaneous or induced) are not available in the registers. The follow-up period was relatively short when estimating the likelihood of giving birth. In Sweden, the mean age of giving birth to the first child was 27.7 years in 2000 [25] at which point the women in the present study were 25-27 years of age. We studied hospitalisations, not morbidity, since outpatient data is not recorded in Swedish nationwide registries.

However, hospitalisations could be regarded as a proxy for a substantial part of the morbidity. Hospitalisation was treated as a dichotomy because the likelihood of hospitalisation and its duration due to certain diagnoses may change over time. For example, the average number of days of hospitalisation has decreased from 20.8 in 1987 to 7.6 in 1996 [26,].

We found that a majority of the causes of hospitalisation during adolescence increased the likelihood of giving birth in the age groups studied, although other studies suggest a reduction in fertility following certain morbidity [1,3-7,27-29]. There are suggestions that chronic illness and adolescent-onset psychiatric disorders are positively connected to sexual risk-taking behaviour and increased risks for teenage pregnancies [8-10]. As the relation between hospitalisation during adolescence and the likelihood of giving birth tended to decrease by age, one might speculate that residual confounding by social and behavioural factors is involved in explaining some of the positive relations found. The age dependence of the results

also underlines the importance of a longer follow up time. This will show if the total birth rate is affected or if it is more a question of timing.

Some gynaecologic disorders such as endometriosis and hyper-androgenic disorders are associated with reduced fertility [27,28]. In the present study, women who were hospitalised due to ‘diseases of the genitourinary system’ but not endometriosis had a higher likelihood of giving birth. Diagnoses connected to abdominal problems also seemed to be positively connected to the outcome studied. Abdominal and pelvic pain is common in the adolescent woman, and might be related to pelvic inflammatory disease [30]. One explanation might be that these women have a higher sexual risk-taking behaviour as explained by the connection between STI, sexual risk-taking behaviour and pelvic inflammatory disease and related sequels [1,6,7]. The positive connection found between ‘other diseases due to viruses and chlamydia and the likelihood of giving birth could have the same explanation.

Women hospitalised according to ‘mental disorders’ during adolescence had an increased likelihood of giving birth between 20 and 24 years of age but a reduced likelihood between 25 and 27 years of age. Thus the effect was therefore mainly on timing of birth. Previous authors have found an association between early psychiatric disorders and teenage pregnancies (8). A reduction in likelihood by age was also observed for ‘injury, poisoning, and other external causes’. Previous research implies that morbidity related to ‘diseases of the nervous system’ and ‘congenital anomalies’ has a negative effect on future fertility [3,5], which is in line with our findings. However, we also found that women hospitalised due to ‘migraine’ had a higher likelihood of giving birth. One explanation could be that migraine tends to worsen when oral contraceptives are used [31] why these women may have higher ‘risks’ for (unplanned) pregnancy. Higher likelihood of giving birth was also found for other groups of diagnoses, such as ‘diseases of the respiratory system’. Atopy, related to asthma, has been suggested to

increase the chance of conception [32,33]. Chronic diseases or life-threatening episodes of sickness may lead to the women reprioritising their lives by desiring children at an early age.

In summary we found that a majority of the causes of hospitalisation during adolescence increased the likelihood of giving birth at ages 20 to 27, even after adjustments for socio-economic characteristics and factors related to each of the studied women's own birth. More detailed studies, including longer follow up are needed in order to understand the mechanisms behind the relations found.

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