ADVERSE PERINATAL CONDITIONS INCREASE THE RISK OF USING DISABILITY PENSION EARLY IN LIFE

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ABSTRACT

Objective: The number of young adults on disability pension is increasing in European raising questions on the related risk factors. This study aims to investigate whether adverse perinatal conditions are associated with receiving a disability pension early in life.

Methods: The study consisted of 453,223 individuals born in Sweden in 1973–1977, observed at ages 16–37 from 1991 through 2010. Statistics Sweden provided linked data on the children and their parents. We used logistic regression to assess the association between perinatal health conditions and receiving a disability pension, adjusting for maternal education and the sex of the child.

Results: New recipients of disability pension were significantly more likely to have a birth defect (Adjusted Odds Ratio [AOR] 6.63, 95% CI: 5.98 -7.34), and be small for gestational age (AOR 2.24, 95% CI: 2.17–2.85). Apgar score was significantly associated with starting to receive a disability pension at ages 16 through 18 and 19 through 29, but not at ages 30 to 33. Women had lower odds of receiving a disability pension at ages 16 to 18, however, this reversed from age 19 and upwards. Persons with higher maternal education were less likely to receive a disability pension compared to persons with <=9 years of maternal education level. Overall, the effects of the studied perinatal health conditions were strongest in those 16 to 18 years at disability pension, but reduced as age increased.

Conclusion: Having a birth defect was the strongest indicator of receiving a disability pension during early adulthood, followed by small for gestational age, and low Apgar score. Our findings suggest that policies and programs geared at promoting optimal health at birth might improve overall health over the lifespan, contributing to a reduction in receiving early disability pensions, and dependence on health services and social welfare.

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INTRODUCTION

Over the past few decades, Europe has witnessed an increase in the number of people receiving disability pensions, [1, 2] with several countries reporting an increase in the number of young adults as new recipients. [2] Disability pensions are a social security scheme that provides income support to people of working age with long-term limitations in their working capacity due to ill health. [3, 4] Disability pension is an important part of the public support programs for people with disabilities in Sweden. [3, 4] Receiving a disability pension has also been viewed as an indicator of long-term ill health, and once on disability pension, very few recipients return to active work. [1] This trend of early exit from the labor force via disability pension is highly unsustainable over time, as it increases financial pressures on the government, and aggravates the anticipated future labor force shortage due to the aging population. [2]

Several studies have attempted to understand the factors associated with the risk of utilizing a disability pension. A growing body of research has identified several socio-economic and health factors associated with the receipt of disability pensions. [2, 5] Some of these identified adulthood socio-demographic risk factors included education, occupation, civil status, family structure, and place of residence.[6-12] Individuals receiving disability pensions also have more adverse health outcomes, such as poor self-rated health, alcohol use, frequent use of primary health care, and noted genetic differences. [7, 10, 13-15]

A few studies using the life course critical model [16] have also investigated the link between childhood conditions and receiving a disability pension later in life. The critical model

112 suggests that suboptimal perinatal conditions cause long-lasting changes in the developing
113 organ structures, and in the functioning of biological systems, which in turn places an
114 individual at an increased risk of chronic diseases during adulthood. [16] Additionally, a
115 handful of studies established a link between childhood socio-economic position and the risk
116 of having a disability later in life. [17, 18] Some studies noted that receiving a disability
117 pension during adulthood was higher among persons with low birth weight, [19, 20] and
118 among those born small for gestational age. [11] However, this evidence on the linkage
119 between perinatal health and the receipt of a disability pension during early adulthood is still
120 insufficient.

121 From our literature search, we identified no single study that has investigated the association
122 between receiving a disability pension and having a birth defect, and a low Apgar score. We
123 think that these associations are worthy of further investigation, as some evidence suggests
124 that persons with birth defects are more likely to report a developmental disability later in life.
125 [21-23] Some studies have reported a link between a low Apgar score at five-minutes and
126 minor disabilities at school age. [24] A low Apgar score was also associated with a neurologic
127 disability in early adulthood. [25, 26] Factors associated with an increased risk of any form of
128 disability affect one's overall quality of health, and as such, are likely to increase the risk of a
129 work disability that leads to receiving a disability pension. Thus, we hypothesize that having a
130 birth defect and a low Apgar score is associated with receiving a disability pension. To test
131 this hypothesis, we followed the birth cohort of 1973–1977 from ages 16 to 37, with the aim
132 of investigating the association between perinatal health factors, as measured by birth defects,
133 Apgar score, and being small for gestational age, and the receipt of a Swedish disability
134 pension during early adulthood.

135

MATERIALS AND METHODS

The study population consisted of 453,223 individuals belonging to five complete birth-year cohorts from 1973 to 1977, who were in Sweden between ages 16–37, during the study period of 1991 to 2010. Initially, we had identified 693,247 individuals belonging to this birth cohort, but 240,024 were excluded, as some were born outside of Sweden, some died, and others emigrated either before or during the study period (details in Figure 1).

(Figure 1 here)

The Swedish Medical Birth Register provided information on the total newborn population, and their perinatal health outcomes. This register also collects information on all congenital anomalies observed during the first year of life. [27] We obtained information on sex, mother's education level, and receipt of disability benefits from the Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA database). Statistics Sweden linked the index person's data and the data of their mother obtained from these two data sources, using the unique Swedish personal identity number (PIN). After data linkage, Statistics Sweden made the data anonymous before delivering it to the Swedish Initiative for Research on Microdata in Social and Medical Sciences (Umeå SIMSAM Lab), [28] where we performed all analyses.

Study variables

Receiving a disability pension: This outcome variable was measured when the individuals were between the ages of 16 to 37. Sweden uses a systematic medical examination, as codified by Swedish social security legislation, to measure diminished health and work capacity when assessing eligibility to receive this financial benefit. [3-5] However, Swedish disability pension legislation has frequently changed. From 1991–2002, individuals were

eligible to receive a disability pension if they were between ages 16–64, with medical evidence confirming their inability to work due to chronic ill health. [3, 4] From 2003 onwards, the basis for granting this financial security remained the same, but the minimum age limit was raised to age 19, and the term disability pension was replaced with activity compensation, which is payable to persons aged 19–29, and sickness compensation, payable to persons aged 30–64. In this paper, we use the term disability pension as an umbrella term that includes disability pension, activity compensation, and sickness compensation. We recorded individuals as having received a disability pension from their first year of receiving the benefit, "yes" for those who received a disability pension and "no" for those who did not.

When selecting explanatory variables, we included perinatal health indicators because previous research suggests a link, [19–23] and/or because we considered them plausible risk factors for receiving a disability pension. We obtained the variable birth defect from the Medical Birth Register, already coded in the register as yes and no. The variable Apgar score at five minutes measures the physical condition of the newborn at 5 minutes after birth on a scale of 0–10. [29] We categorized this variable according to existing criteria, which considers a total score of less than 7 as a low Apgar score, while a score within a range of 7 to 10 is considered normal. [29, 30] The variable gestational age was pre-categorized into two groups, based on the Swedish growth standards that account for both birth weight for gestational age and sex. The 5^{th} percentile (z-score below -1.64) was the threshold, individuals below this were pre-categorized as small for gestational age, and those above considered appropriate for gestational age. We categorize sex as either man or woman, and maternal education is categorized into <= 9 years of school (reference category), upper secondary education, and university education.

Statistical analyses

In the descriptive analysis, we used cross tabulation to compare the explanatory variables between individuals who received a disability pension, and those who did not (Table 1). We examined bivariable correlation between birth defect and all other independent variables, and found no evidence of a strong correlation; thus, we chose to keep all of the independent variables. We conducted logistic regression to assess whether any of the perinatal conditions were associated with the odds of receiving a disability pension between the ages of 16–37. We examined the independent association between each of the variables, and the odds of receiving a disability pension (see Bivariable results column in Table 2). In Table 2, Models 1–3, we assessed changes in the odds of receiving a disability pension by adjusting for covariates. In Model 1, we included all perinatal health variables; in Model 2, we added sex and maternal education to Model 1, and in Model 3, we checked for the interactions between sex and all other explanatory variables.

Furthermore, we performed logistic regression analyses to account for the different ages beginning to receive a disability pension (See Table 3). We created separate models using an individual's age at the start of their receiving a disability pension, taking into consideration the changes in the national legislation on disability pensions, i.e. ages 16–18, 19–29, and 30–33. Model 4 measured the odds of receiving a disability pension at ages 16–18, Model 5 estimated the odds of receiving a disability pension at ages 19–29, and Model 6 assessed the odds of receiving a disability pension at ages 30–33. In further analyses, (See Table 4, appendix) we introduced all explanatory variables and interaction terms simultaneously for each of the above that was presented in Table 3. We assessed multi-collinearity for all adjusted models by calculating the variance inflation factor (VIF), regressing each independent variable on all the other independent variables, and found no strong evidence of

multi-collinearity. Using Anova, we evaluated the overall fitness of the model. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported. Statistical significance was attained with a $p<0.05$. We performed our statistical analyses using the R software.

RESULTS

We present the differences in the study population's characteristics in Table 1. The total number of people that began receiving a disability pension between ages 16-37 years, during the duration of the follow-up, was 18,854 (4% of the 453,223 participants). The proportion of individuals with birth defects who received a disability pension was twice as large when compared to individuals without birth defects (8% vs. 4%, respectively). Disability pension reception was more common among females than males, 5% versus 3%, respectively. The prevalence of disability pension reception was highest among those with maternal education less <=9 years of schooling (5%), however, the prevalence was similar among those with mothers with upper secondary or university education (3%).

Table 1. Perinatal characteristics of the birth cohort of 1973–1977 by disability pension status (n=453,223)

Description	***No Disability Pension N=434,369 (96%)***	***(%)***	***Disability Pension N=18,854 (4%)***	***%***
Birth defect				
No	411,498	(96)	16,939	(4)
Yes	19,523	(92)	1,739	(8)
Data Missing	3,348	(95)	176	(5)
Apgar at 5 minutes				
≥ 7	311, 306	(96)	13,159	(4)
<7	4,406	(91)	428	(9)
Data Missing	118,657	(96)	5,267	(4)
Small gestational age				
No	403,644	(96)	16,767	(4)
Yes	18,516	(93)	1,422	(7)
Data Missing	12,209	(95)	665	(5)
Sex				
Male	226,431	(97)	7,941	(3)
Female	207,938	(95)	10,913	(5)
Mother's education				
<9 years	178,468	(95)	8,675	(5)
Upper secondary	159,993	(97)	5,628	(3)
University	32,717	(97)	966	(3)
Data Missing	63,191	(95)	3,585	(5)

In Table 2, all of the bivariable results showed significant associations. Individuals with a birth defect were at higher odds of receiving a disability pension, compared with their counterparts without a birth defect (OR 2.16, 95% CI: 2.05–2.28). Those with low Apgar scores were more likely to receive disability pensions compared to those with Apgar scores of 7–10 (OR 2.29, 95% CI: 2.08–2.54). Persons who were small for gestational age were more likely to receive a disability pension compared to those that were not. Females had higher odds of receiving a disability pension compared to males (OR 1.85, 95% CI: 1.75–1.95). Using <=9 years of maternal schooling as the reference category, those born to mothers with a high level of education were less likely to use the disability pension.

In Model 1, simultaneous adjusting for the three perinatal health variables confirmed significantly increased odds of receiving a disability pension among persons with birth defects, a low Apgar score and who were small for gestational age. In Model 2, we added sex and maternal education to the previous model, and noted that birth defects, low Apgar score, being small for gestational age, and being a woman remained significantly associated with higher odds of receiving a disability pension, while high maternal education was significantly associated with lower odds of receiving a disability pension. In Model 3, we added interaction terms to the previous model (Model 2), the main effect remained significant and in similar direction as observed in the previous model. Model 3 also revealed an interaction between birth effect and sex and an interaction between birth effect and small for gestation age. Using Anova, we evaluated the overall fitness of the models, and found significant evidence of the overall effects of all independent variables on the dependent variable.

Table 2. The unadjusted and adjusted associations between perinatal factors and the receipt of a disability pension

Perinatal factors	*Bivariable results*	*Multivariable results*		
	OR (95% CI)	**Model 1: (n=322,464) OR (95% CI)**	**Model 2: (n=273,708) OR (95% CI)**	**Model 3: (n=273,708) OR (95% CI)**
Birth defect				
No	1.00	1.00	1.00	1.00
Yes	2.16 (2.05─2.28) ***	2.31 (2.18─2.45) ***	2.52 (2.36─2.69) ***	2.74 (2.49─3.00)***
Apgar score				
7-10	1.00	1.00	1.00	1.00
<7	2.29 (2.08─2.54) ***	2.12 (1.91─2.35)***	2.19 (1.95─2.47)***	2.12 (1.77─2.52)***
Small for gestational age				
No	1.00	1.00	1.00	1.00
Yes	1.85 (1.75─1.95)***	1.84 (1.72─1.96) ***	1.73 (1.61─1.86) ***	1.73 (1.54─1.94)***
Sex				
Male	1.00		1.00	1.00
Female	1.49 (1.45─1.54)***		1.54 (1.48─1.59)***	1.55 (1.46─1.64)***
Mother's education				
<9 years	1.00		1.00	1.00
Upper secondary	0.72 (069─0.75) ***		0.76 (0.73─0.79)***	0.74 (0.69─0.79)***
University	0.61 (0.57─0.65)***		0.63 (0.58─0.68)***	0.67 (0.59─0.75)***
Birth defect*sex				
Male: No birth defect				1.00
Female: birth defect				0.85 (0.78─1.02)
Sex*Apgar score				
Male: Apgar 7-10				1.00
Female: Apgar <7				1.07 (0.84─1.35)
Sex*Gestational age				
Male: not SGA				1.00
Female: SGA				1.00 (0.86─1.16)
Mother's education*sex				
Male: <9 years				1.00
Female: Upper secondary				1.04 (0.96─1.13)
Female: University				0.90 (0.77─1.06)
Birth defect*Apgar score				
*Birth defect No*Apgar score 7-10*				1.00
*Birth defect Yes*Apgar score <7*				1.26 (0.89─1.76)
Birth defect *SGA				
*Birth defect No*SGA No*				1.00
*Birth defect Yes*SGA Yes*				1.39 (1.12─1.74)*
SGA*Apgar score				
*SGA No*Apgar score 7-10*				1.00
*SG Yes*Apgar score <7*				0.86 (0.63─1.16)

*Model 1 contains perinatal health variables, Model 2 adds sex and mother's education level to model 1, Model 3 extends Model 2 by including interaction effects. *** indicates p-value <0.001, * p-value<0.05*

In Table 3, we present our investigation of the association between perinatal conditions and the odds of receiving a disability pension in three different age groups. Among those who started receiving a disability pension between ages 16–18 (Model 4), the new recipients were significantly more likely to have a birth defect, a low Apgar score, and to be small for gestational age. Model 5 shows the increased odds of receiving a disability pension between

ages 19–29 among those with a birth defect, a low Apgar score, who were small for gestational age, and women. In Model 6, starting to receive a disability pension between ages 30–33 was associated with having a birth defect and being small for gestational age, but not with a low Apgar score. High maternal education was associated with lower odds of receiving a disability pension for all age groups presented in Table 3.

Table 3 shows the associations between perinatal factors and disability pension reception in the 1973–1977 birth cohort, stratified by age at the start of receiving disability pension and adding all possible interactions

	Model 4: Age 16- 18 years OR (95% CI) (n=)	**Model 5: 19- 29 years OR (95% CI) (n=269,716)**	**Model 6: 30-33 years OR (95% CI) (n=)**
Birth defect			
No	1.00	1.00	1.00
Yes	5.89 (5.06─6.84)***	1.49 (1.24─1.79)***	1.39 (1.08─1.78)**
Apgar score			
7-10	1.00	1.00	1.00
<7	4.25 (3.12─5.66)***	1.53 (1.41─1.67)*	1.25 (0.75─1.97)
Small for gestational age			
No	1.00	1.00	1.00
Yes	2.15 (1.69─2.69)**	1.49 (1.22─1.80)***	1.43 (1.09─1.84)***
Sex			
Male	1.00	1.00	1.00
Female	0.73 (0.64─0.85)***	1.53 (1.41─1.67)***	2.16 (1.95─2.40) ***
Mother's education			
<9 years	1.00	1.00	1.00
Upper secondary	0.75 (0.66─0.85)***	0.71 (0.65─0.79)***	0.72 (0.64─0.82)***
University	0.76 (0.59─0.96)*	0.66 (0.54─0.79)***	0.56 (0.43─0.73)***
Interaction terms			
Birth defect*sex			
Male: No birth defect	1.00	1.00	1.00
Female: birth defect	1.27 (1.03─1.58)*	0.99 (0.78─1.26)	0.88 (0.64─1.21)
Apgar score*sex			
Male: Apgar 7-10	1.0	1.00	1.0
Female: Apgar <7	1.22 (0.82─1.80)	1.46 (0.98─2.20)	0.85 (0.47─1.55)
Sex*Gestational age			
Male: not SGA	1.00	1.00	1.00
Female: SGA	1.39 (1.04─1.86)**	1.02 (0.81─1.30)	0.98 (0.72─1.35)
Mother's education*sex			
Male: <9 years	1.00	1.00	1.00
Female: Upper secondary	1.21 (0.99─1.47)	1.11 (0.98─1.25)	0.97 (0.83─1.14)
Female: University	1.25 (0.88-1.77)	0.93 (0.73─1.19)	0.84 (0.59─1.18)
Birth defect*Apgar score			
*Birth defect No*Apgar score 7-10*	1.00	1.00	1.00
*Birth defect Yes*Apgar score <7*	0.90 (0.57─1.40)	0.86 (0.39─1.67)	1.07 (0.31─2.76)
Birth defect *SGA			
*Birth defect No*SGA No*	1.00	1.00	1.00
*Birth defect Yes*SGA Yes*	1.15 (0.83─1.58)	1.27 (0.82─1.89)	1.06 (0.55─1.86)
SGA*Apgar score			
*SGA No*Apgar score 7-10*	1.00	1.00	1.00
*SG Yes*Apgar score <7*	0.56 (0.34─0.91)*	0.84 (0.49─1.37)	1.29 (0.61─2.52)

Models 4–6 contain all the studied perinatal variables, showing the main effect and interaction effects.
**** indicates p-value <0.001, * p-value<0.01 and * p-value<0.05*

DISCUSSION

Our findings support the study's main hypothesis that having a birth defect is significantly associated with beginning to receive a disability pension during early adulthood. A low Apgar score was associated with receiving a disability pension before age 30, but not afterwards. We confirmed an association that was observed earlier between being small for gestational age and increased odds of receiving a disability pension. Women were less likely to receive a disability pension between ages 16–18, but had increased odds of receiving a disability pension from age 19 onwards. We further observed that the effect of perinatal health was strongest among those who started to receive a disability pension between ages 16–18, but the strength of the association reduced as age when beginning to receive a disability pension increased, even though this effect remained statistically significant. Compared to persons with maternal education <9 years, individuals with higher maternal education level were significantly less likely to receive a disability pension as age increased.

The strength of our study stems mainly from using register data with a nationwide coverage, which ensured high completeness, limited follow-up loss, and no recall bias. This study suffers from some limitations, such as a potential selection bias relating to death as an exclusion criterion. Children with adverse perinatal health outcomes are most likely to die, and hence the exclusion of children who died might have led to underestimations of the effect, and potentially a selection bias. However, we still observed high odds among those with adverse health indicators. Our results reflect the situation among those who were alive from ages 16 to 37. The change in the minimum age eligibility for the disability pension, from age 16 to age 19 in 2002, might have led to classification bias in our study. However, we consider this a minor problem, because the eligibility criteria remained based on the presence of a long-term work disabling health condition, both prior to and beyond 2002. [39] Additionally,

we considered the legislation change by analyzing data for the different age groups separately, i.e. ages 16–18, 19–29, and 30–33.

As far as we know, ours is the first study to investigate the associations between birth defects, Apgar score at 5 minutes, and receiving a disability pension between ages 16–37. Our findings confirm our hypothesis that having a birth defect and low Apgar score is associated with increased odds of receiving a disability pension early in life. These observations are biologically plausible, as existing literature already suggests a link between birth defects, [21, 23] low Apgar score at 5 minutes, and disability indicators such as a developmental disability. [25, 26] Our finding that individuals who were small for gestational age were more likely to receive a disability pension during early adulthood supports earlier studies that report similar associations. [11, 19, 20] We observed interaction between birth defect and being born small for gestational. The increased odds of receiving disability pension for individuals with adverse perinatal health might imply ill health over the lifespan, given that prolonged ill health is a legal requirement for receiving a disability pension. [5, 31]

We report that the effects of the perinatal health factors appeared to weaken as age at beginning to receive a disability pension increased. This might imply that individuals who had severe health problems needed to start receiving a disability pension earlier. It could also be that, as these individuals get older, the effects of adulthood exposures become pronounced, outweighing the effects of the perinatal health factors. Future studies extending the model to include adult factors could help clarify this association.

The fact that higher odds of receiving a disability pension were associated with low maternal education concurs with the theory of fetal origin. Low education possibly indicates a poor maternal socio-economic position, predisposing offspring to further socio-economic, behavioral, and pathological disadvantages across the lifespan [16, 19] that eventually lead to

receipt of a disability pension. Our finding that women were more likely to receive a disability pension is in line with reports from earlier studies in Sweden [1, 2], and from other European countries. [31] We observed that women had lower odds of receiving a disability pension at ages 16–18, but had higher odds from age 19 and onwards. Earlier studies have also reported gender differences in the use of disability pensions. [1, 6, 20, 31, 32] Gravseth noted an increase in women's incidence rates beginning in their late twenties and onwards, but not before this age. [20] The explanation for these gender differences is not clear, but previous research has attributed it to the underlying gender structure that dictates gendered living and working conditions, exposing women engaging in paid work to a "double burden" that results from combining work and responsibility for the home and children. As a result, women's health tends to suffer as they reach the age that requires combining gainful employment with family life. [33, 34] However, these observed differences could perhaps be due to other health and socio-economic conditions outside the scope of this study.

CONCLUSION

This study provides evidence of an association between birth defects, low Apgar score at 5 minutes, and the increased odds of receiving a disability pension, taking other early life health and maternal measures into consideration. The confirmed association points to the complexity in the relationship between early life conditions and the later receipt of a disability pension. Our findings contribute to previous knowledge on the predictors of disability pension receipt, highlighting a need for better-focused strategies to promote early health, as this could contribute to reduced work incapacity during the early stages of adulthood. This is critical to consider, because evidence suggests that the majority of people that start to receive a disability pension tend to do so on a long-term basis. Among females, increase in age was

associated with a higher use of a disability pension. Our findings suggest that those with poor perinatal outcomes are likely to be more susceptible to disabling chronic conditions in early adulthood, reducing their work capacity and hence fostering a need to receive a disability pension. The fact that those with poor health indicators at birth, and children of mothers with low education, were more likely to receive a disability pension suggests a need for a continued review of public and social policies aimed at improving early life conditions. This would contribute to a reduction in the number of disability pension recipients, and to an improvement in overall societal health and well-being.

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