Long term effects of parental disability:
A register based life course follow-up of Norwegians born in 1967-1976

Petter Kristensen[1], Tor Bjerkedal[2] and John Ivar Brevik[2]

[1] *National Institute of Occupational Health, P.O. Box 8149 Dep, 0033 Oslo, Norway*
[2] *Division of Military Medical Research and Development, Joint Norwegian Medical Services, 0753 Oslo*

Correspondence: Petter Kristensen, MD, PhD, National Institute of Occupational Health, P.O. Box 8149 Dep, NO-0033 Oslo, Norway
Telephone: (+47) 23 19 53 73 Telefax (+47) 23 19 52 00 e-mail: petter.kristensen@stami.no

SUMMARY

Background: Health and social conditions early in life has been associated with health and social function in adult age. However, the specific relation between parental disability in early life and adult function has not been subject to epidemiological investigation. We investigated the association between parental disability pension in childhood and adolescence, and subsequent outcomes related to health and social function in young adult age.

Methods: Through linkage between several national registers containing personal information from birth into adult age we established a longitudinal, population based cohort. Study participants were all subjects born in Norway in 1967–1976 who were national residents at age 18 (N=610 981). The study outcomes were educational attainment, intellectual level, mortality, disability pension, work participation, and sickness absence in young adult age.

Results: Parental disability pension was, after adjustment for potential confounders, moderately associated with low educational attainment, low intellectual performance, increased mortality, lack of work participation, and increased number of sickness absence spells. The association was strongest for own disability pension when attaining adult age (hazard ratio (95% confidence interval) was 1.98 (1.81–2.17) for women and 1.94 (1.79–2.11) for men). The hazard of own disablement pension was higher when the parent of one's own gender was disabled than for the parent of opposite gender, and the effect was stronger when the parent had been disabled from the first years of the child's life.

Conclusion: Growing up with disabled parents has adverse consequences on health and social function into young adult age.

Key words: Adult; Child; Cohort studies; Disability; Education; Employment; Follow-up studies; Intellectual performance; Sickness absence; Social environment

INTRODUCTION

The establishment of life course cohorts has been an advancement in the study of social inequalities of health (1,2). The British birth cohorts established in 1946 (3), 1958 (4) and 1970 (5) are examples of cohorts being followed up for decades. These cohorts provide firm documentation of the long-term effects of childhood social conditions on adult health and social function, both with childhood conditions as principal determinants (3,4) and as potential confounders (3,5).

Father's social class has been the main childhood social factor being considered in long term follow-up. We are not aware of any epidemiological study addressing the long term consequences of growing up with disabled parents. However, both British (3) and Scandinavian studies (6-11) have examined the impact of childhood experience on disability later in life, applying both longitudinal (3,6) and cross-sectional (7-11) designs.

Disability is strongly related to low socioeconomic status (12). Children with disabled parents will therefore be more likely to experience early social disadvantage apart from direct consequences of the disability. Parental disability could also have direct effects on adult age functions, e.g. by influencing role modelling.

To study the association between parental disability in childhood and adolescence, and subsequent outcomes related to health and social function in young adult age, we examined data from several population based national registers in Norway. The objective was to quantify the impact of parental disability on a number of adult age outcomes: educational attainment, intellectual level, mortality, disability pension, work participation, and sickness absence. One specific aim was to assess whether effects of parental disability could be fully explained by socioeconomic status, alternatively, that effects act directly.

METHODS

Participants and linking procedures

The study population included all 626 928 subjects in the Medical Birth Registry of Norway, live born in 1967-1976. Using the national identification number, we linked individual records in the Birth Registry,

benefit and income registers in the National Insurance Administration, records in the Norwegian Armed Forces Personnel Data Base, the education register in Statistics Norway, and the Central Population Register. After exclusion of 11 611 deaths (1.9%) and 4336 emigrations (0.7%) between birth and the year of their 17th birthday, 610 981 *index persons*, 298 220 women and 312 761 men, remained for analysis.

Determinants and outcome measures under study

Linkage provided longitudinal data for the index persons and their parents. Data were updated at least through the year 2001 on social benefits, pensionable income, education, death and emigration, as well as marital status and childbirth. The sources of the main data in the current analyses were the Central Population Register (updated information on date of death or emigration), the National Insurance Administration (annual data on pensionable income and disability pension benefit, 1967-2001, and number of sickness absence spells, 2000-2002), the Norwegian Armed Forces Personnel Data (intellectual performance test results, men only), and Statistics Norway (annual data on ongoing education and educational attainment).

The main study determinant was disability pension given to one or both parents before or during the index person's childhood and/or adolescence (i.e., before the calendar year of the 18th birthday). We divided this variable into subsets: maternal disability pension and paternal disability pension, as well as maternal or paternal disability pension by category of index person age (0-6 years, 7-12 years, or 13-17 years).

We used six study outcomes:

- Index persons with data on educational attainment (2714 missing) were divided into five levels: university (estimated duration 18 or more years), college (14-17 years), post-secondary (12-13 years), upper secondary (10-11 years), and lower secondary or less (0-9 years). Education level was dichotomised in the multivariate analysis, lower secondary or less being defined as low educational attainment.
- Military duty is mandatory for all men in Norway. Potential conscripts are usually examined and classified at age 18 or 19. Examination includes several tests. We used performance on general intellectual level (nine levels from low (1) to high (9)) as an outcome (26 283 had missing information). Level 1-2 (low intellectual performance) served as outcome in the multivariate analysis.
- Mortality was recorded during eight years for all index persons (calendar years between ages 18 and 25).
- Disability pension was recorded during eight years for all index persons (calendar years between ages 18 and 25) excluding 1634 subjects with disability pension given before the calendar year of their 18th birthday.
- Pensionable income in the calendar year of the 30th birthday was recorded for index persons born in 1967-71 who were alive and national residents throughout the same year, and were not receiving disability pension during this year (1997 for 1967 births to 2001 for 1971 births; N=307 338). Personal earnings are reported annually to the National Insurance Administration to estimate forthcoming old age pension. This pensionable income is recorded in basic units that are adjusted regularly in accordance with changes in the general income level. An income of half a basic unit (equalling nearly €3500 in 2002) is the limit entitling sickness absence compensation, accordingly, we defined an income lower than half a basic unit as lack of income. In the multivariate analysis, index persons who had a lack of income and who were not under education in the calendar year of their 30th birthday were considered as not participating in work.
- Number of sickness absence spells between January 1st, 2000, and September 30th, 2002, were collected for index persons born in 1967-1971 who were alive and national residents. Furthermore, we only included those who were entitled to allowance during illness (annual income at least half a basic unit) and did not receive disability pension or vocational rehabilitation benefit (N=218 674). More than five spells during the 33 months were classified as high level of sickness absence and used as outcome in the multivariate analysis.

We considered covariates potentially related to the study outcomes (table 1). The Education Register provided data on residential region as well the highest educational achievement for both parents in the year of the index person's 16th birthday. The Medical Birth Registry included data on parity and the mother's marital status at birth. From the Central Population Register we obtained data on maternal marital status when the index person was a teenager (in 1985 for 1967-1972 births; in 1992 for 1973-1976 births). We constructed a variable on change in marital status by index person age: Married at both occasions, married at birth but not in the teens, married in the teens but not at birth, and not married in either of the two occasions. The Central Population Register provided data on both parents' year of birth and number of children. We received data on annual pensionable income and pension benefits for both parents in the income and benefit registers, respectively. Annual recordings of index persons' basic and attendance benefit (13) during childhood were retrieved in the Benefit Register.

Analysis

All analyses were performed in SPSS, version 11.5. We examined gender-specific distributions, by category of parental disability, of level of educational attainment, intellectual performance level (men), pensionable income at age 30, and number of sickness absence spells.

Table 1. Characteristics of 610 981 Norwegians who were alive and national residents in the calendar year of their 18th birthday, and proportions within categories who grew up with parents qualifying for disability pension.

Category	Number	% of total	% with parental disability
Total	610 981	100	10.0
Year of birth			
1967	64 388	10.5	9.5
1968	65 574	10.7	9.6
1969	66 007	10.8	9.5
1970	63 088	10.3	9.7
1971	63 870	10.5	10.2
1972	62 704	10.3	10.3
1973	59 758	9.8	10.4
1974	58 241	9.5	10.4
1975	55 056	9.0	10.2
1976	52 295	8.6	10.1
Geographical region			
South-East	247 342	40.5	9.4
South	60 704	9.9	13.0
West	166 926	27.3	8.0
Mid Norway	57 971	9.5	9.6
North	75 953	12.4	14.0
Missing information	2085	0.3	8.1
Birth order			
First	245 528	40.2	6.1
Second	198 725	32.5	8.6
Third	100 469	16.4	13.1
Fourth	40 773	6.7	19.4
Fifth or more	25 486	4.2	31.0
Maternal marital status according to index person's age			
Married both at birth and in teens	466 509	76.4	8.6
Married at birth, not in teens	79 620	13.0	18.2
Not married at birth, married in teens	27 227	4.5	6.6
Not married at birth nor in teens	19 721	3.2	14.6
Incomplete information	17 904	2.9	10.9
Maternal and paternal number of offspring			
Equal	537 387	88.0	9.1
Not equal	73 594	12.0	16.5
Maternal age at index person's birth			
<20	46 605	7.6	6.4
20-29	418 801	68.5	7.6
30-34	93 071	15.2	13.5
35-39	39 274	6.4	23.1
≥40	13 227	2.2	33.7
Missing information	3	0.0	0.0
Paternal age at index person's birth			
<20	5188	0.8	5.5
20-29	331 024	54.2	6.4
30-34	125 412	20.5	9.6
35-39	63 183	10.3	15.7
≥40	47 155	7.7	29.9
Missing information	39 019	6.4	9.2
Maternal educational attainment			
University	6440	1.1	2.4
College	78 596	12.9	4.4
Post-Secondary	43 803	7.2	4.9
Upper Secondary	282 269	46.2	8.2
Lower secondary or less	195 196	31.9	16.2
Unknown	4677	0.8	13.2
Paternal educational attainment			
University	40 151	6.6	2.9
College	76 019	12.4	4.3
Post-Secondary	113 372	18.6	7.1
Upper Secondary	199 504	32.7	9.6
Lower secondary or less	170 628	27.9	16.5
Unknown	11 307	1.9	12.4
Disease benefit (index person, 0-16 years)			
No	597 457	97.8	9.8
Basic benefit only	5487	0.9	16.4
Assistance benefit (with or without basic benefit)	8037	1.3	18.0

We used Cox regression procedures in the multivariate analyses. By fixing time to be unity in all subjects (14), prevalence ratios were computed for low education, low intellectual performance, no work participation, and high level of sickness absence in association with parental disability pension. We estimated hazard ratios in an ordinary Cox regression for mortality and disability pension between ages 18 and 25 in association with parental disability pension. In the mortality analysis, emigrating subjects were censored out. In the disability analysis, deaths and emigrations were censored out.

We estimated crude and adjusted ratio estimates of associations with parental disability and 95% confidence intervals. Variables listed in table 1 were considered to be potential confounders and were included in the multivariate models, using the categories in table 1. All analyses were performed separately for women and men. In addition to estimating effects of parental disability pension, we also analysed separate effects of maternal and paternal pension as well as effects of maternal and paternal pension in separate index person age strata.

RESULTS

Parental disability pension was associated with decreasing level of educational attainment, decreasing pensionable income, and increasing number of sickness absence spells in both genders, furthermore, with decreasing intellectual performance among potential male conscripts (figures 1-4).

The same pattern was evident for crude associations with dichotomous outcomes for both women (table 2) and men (table 3): Parental disability pension was moderately or strongly associated with low educational attainment, low intellectual performance (men), increased mortality, index person disability pension, no work participation at age 30, and a high level of sickness absence. The adjusted analyses show that these relations were, to a large degree, due to covariate confounding. Throughout, maternal educational attainment seemed to be the strongest confounder (data not shown). About 2% of the population had received disease benefit in childhood, but this was nevertheless a strong confounder for the association with index person disability pension (data not shown). The adjusted ratio estimates were mostly in the 1.2–1.4 range, but considerably stronger for index person disability pension for both genders with ratio estimates approaching two (tables 2 and 3). Sickness absence and particularly work participation results showed stronger associations for men than for women (tables 2 and 3).

When we applied analysis according to pension for each parent and for specific index age strata, a clear pattern was evident for index person disability pension. The association was stronger for maternal than for paternal pension for women, whereas the paternal pension effect was stronger for men (table 4). Furthermore, effects were clearly stronger when the parent received pension during the index person's first years of life (table 4). Results for other outcomes were generally not very different for maternal and paternal effects (data not shown). Neither were effects clearly dependent on index person age when the parent had received pension, although there might be a general tendency toward stronger effects for younger ages (data not shown).

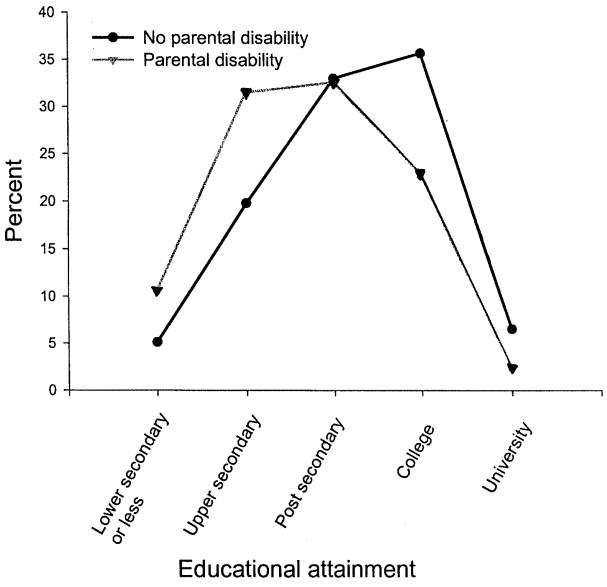

Figure 1a. Distribution of level of educational attainment by category of parental disability pension. Women born in 1967-1976.

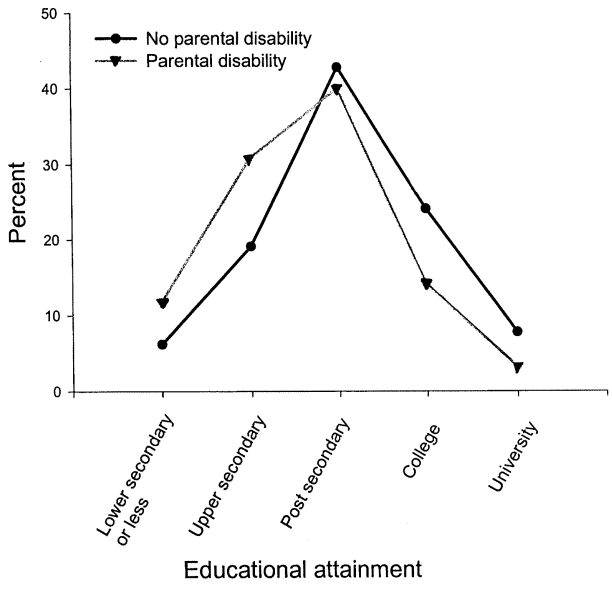

Figure 1b. Distribution of level of educational attainment by category of parental disability pension. Men born in 1967-1976.

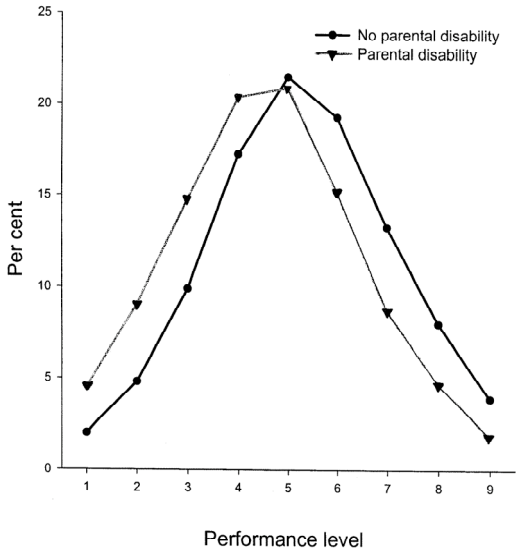

Figure 2. Distribution of level of intellectual performance (on a scale from low (1) to high (9)) at military duty test, by category of parental disability pension. Men born in 1967-1976.

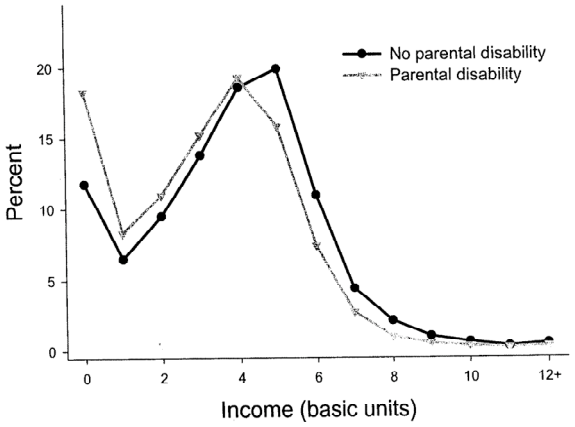

Figure 3a. Distribution of income level in basic units at age 30 by category of parental disability pension. Women born in 1967-1971.

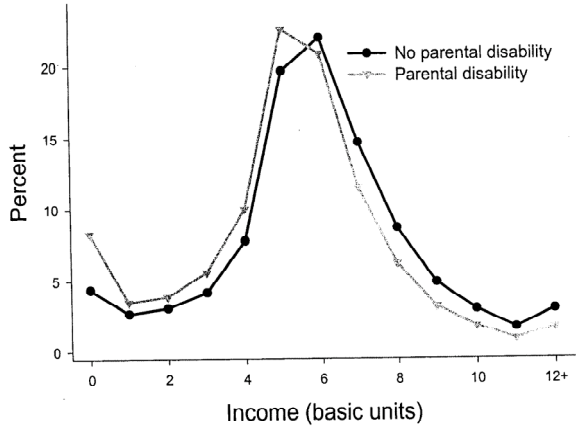

Figure 3b. Distribution of income level in basic units at age 30 by category of parental disability pension. Men born in 1967-1971.

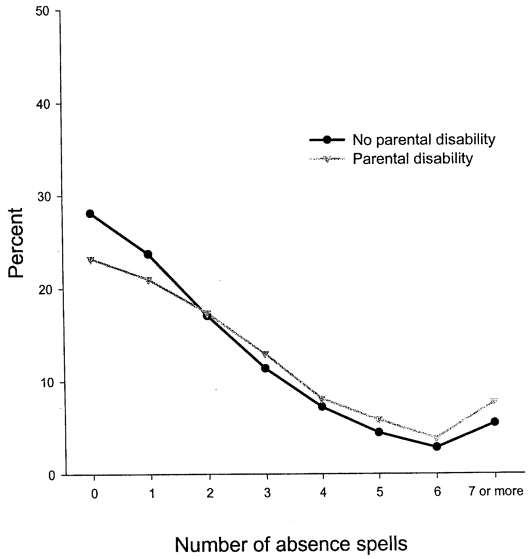

Figure 4a. Distribution of sickness absence spells between January 1st, 2000, and September 30th, 2002, by category of parental disability pension. Women born in 1967-1971.

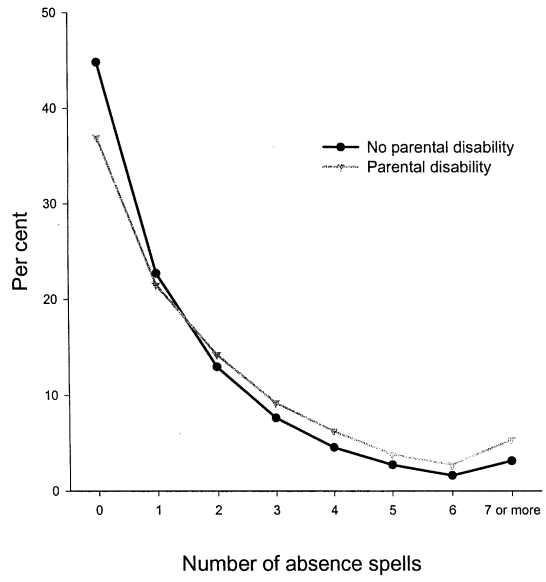

Figure 4b. Distribution of sickness absence spells between January 1st, 2000, and September 30th, 2002, by category of parental disability pension. Men born in 1967-1971.

DISCUSSION

The results show that parental disability pension in childhood and adolescence was associated with a number of adult outcomes related to cognitive ability, health, and social function in adult age. Partly, the rather strong relations between parental disability and a number of other disadvantageous factors in early years may explain these associations. Disabled parents tend to be recruited from a poorer social background (12) than other parents, and their children tend to have more chronic disease. Apart from this confounding,

Table 2. Associations between parental disability pension in childhood and different functions in adulthood among 298 220 women, born in 1967-1976, who were alive and national residents through the calendar year of their 17th birthday.

Outcome/			Number with	Proportion	Crude		Adjusted*	
Determinant category	N	%	outcome	with outcome	Ratio	95% CI	Ratio	95% CI
Low educational attainment †								
Parental disability pension								
No	267 513	90.0	13 641	0.051	1	Reference	1	Reference
Yes	29 659	10.0	3146	0.106	2.08	2.00–2.16	1.39	1.33–1.45
Index person death (follow up age 18-25)								
Parental disability pension								
No	268 336	90.0	607	0.002	1	Reference	1	Reference
Yes	29 884	10.0	97	0.003	1.44	1.16–1.78	1.21	0.96–1.51
Index person disability pension (follow up age 18-25) ‡								
Parental disability pension								
No	267 718	90.0	2279	0.009	1	Reference	1	Reference
Yes	29 784	10.0	762	0.026	3.03	2.79–3.29	1.98	1.81–2.17
No work participation at age 30 §								
Parental disability pension								
No	135 773	90.4	11 392	0.084	1	Reference	1	Reference
Yes	14 340	9.6	1975	0.138	1.64	1.57–1.72	1.37	1.30–1.44
High level of sickness absence §								
Parental disability pension								
No	88 435	91.2	7097	0.080	1	Reference	1	Reference
Yes	8568	8.8	989	0.115	1.44	1.35–1.54	1.29	1.20 –1.38

* Adjusted for year of birth, geographical region, birth order, maternal marital status according to index person's age, equality in parents' number of children, maternal and paternal age at index person's birth, maternal and paternal educational attainment, and childhood disease benefit.

† Excluding 1048 women with missing information.

‡ Excluding 718 women receiving disability pension before the calendar year of her 18th birthday.

§ Women born in 1967-71.

the results indicate that parental disability may have a moderate independent effect. This independent effect was considerably stronger for disability pension for the index person herself or himself. The association with lack of work participation among subjects who did not receive disability pension was stronger for men than for women. The hazard of own disablement pension was higher when the parent of one's own gender was disabled than for the parent of opposite gender, and the impact was stronger when the exposure to parental disability was taking place in the first years of life. This pattern may indicate that disability pension can be influenced by role models across generations; from father to son and from mother to daughter.

Our study adds to the literature showing that adverse conditions in childhood and adolescence may compromise adult social function and health (3-5). We show that parental disability may be included as one of the factors that could have adverse effects years later, in adulthood. We have shown earlier that childhood social conditions in general have more impact on work participation among men than among women (15). The present study seems to confirm that this tendency is true for parental disability as well.

Register-based life course cohorts may be an alternative to conventional prospective life course cohorts. A cohort establishment based on several national registers along the life course is possible in Norway due to the unique national identification number assigned to all residents. Among the virtues are feasibility and cost-effectiveness, furthermore, nearly complete follow-up of subjects and large size. For some outcomes, the overall loss in follow-up was less than 3% and due to death and emigration. In this respect, our register follow-up study has an advantage over the British birth cohorts (3-5) with loss at adult age of approximately half the participants (16).

Register based cohort studies might encounter problems as well. Our study shows that there may be limitations related to some of the data at hand. Some registers are mainly administrative and data often tend to be proxies for what we are really looking for in research. One problem concerns interpretation of the results. The relation with parental disability was, not unexpectedly, strongest for disability in the next generation. Paternal disability having more impact on sons

Table 3. Associations between parental disability pension in childhood and different functions in adulthood among 312 761 men, born in 1967-1976, who were alive and national residents through the calendar year of their 17th birthday.

Outcome/			Number with	Proportion	Crude		Adjusted*	
Determinant category	N	%	outcome	with outcome	Ratio	95% CI	Ratio	95% CI
Low educational attainment †								
Parental disability pension								
No	280 290	90.1	17 306	0.062	1	Reference	1	Reference
Yes	30 805	9.9	3608	0.117	1.90	1.83–1.97	1.32	1.27–1.37
Low intellectual performance at military conscript ‡								
Parental disability pension								
No	259 192	90.5	17 668	0.068	1	Reference	1	Reference
Yes	27 286	9.5	3690	0.135	1.98	1.92–2.06	1.32	1.27–1.37
Index person death (follow up age 18-25)								
Parental disability pension								
No	281 568	90.0	2123	0.008	1	Reference	1	Reference
Yes	31 193	10.0	360	0.012	1.53	1.37–1.71	1.29	1.14–1.45
Index person disability pension (follow up age 18-25) §								
Parental disability pension								
No	280 800	90.0	2577	0.009	1	Reference	1	Reference
Yes	31 045	10.0	938	0.030	3.33	3.09–3.59	1.94	1.79–2.11
No work participation at age 30 ¶								
Parental disability pension								
No	142 588	90.7	4064	0.029	1	Reference	1	Reference
Yes	14 637	9.3	886	0.061	2.12	1.98–2.28	1.74	1.61–1.88
High level of sickness absence ¶								
Parental disability pension								
No	110 701	91.0	5205	0.047	1	Reference	1	Reference
Yes	10 970	9.0	878	0.080	1.70	1.59–1.83	1.42	1.31–1.53

* Adjusted for year of birth, geographical region, birth order, maternal marital status according to index person's age, equality in parents' number of children, maternal and paternal age at index person's birth, maternal and paternal educational attainment, and childhood disease benefit.

† Excluding 1666 men with missing information.

‡ Excluding 26 283 men with no test result.

§ Excluding 916 men receiving disability pension before the calendar year of his 18th birthday.

¶ Men born in 1967-71.

and maternal disability on daughters is certainly interesting, but we lack data to explain this observation. It is also interesting that parental disability in the first years of life have stronger impact, but we are not able to sort out whether this is a cumulative or a critical period effect (17). Secondly, it is fair to assume that covariates included in the multivariate analysis might have measurement error that would result in incomplete adjustment. Thirdly, deciding a logical and optimal analysis strategy is a problem that might be considered inherent in life course analysis (2). It may be difficult to decide whether covariates are potential confounders or mediating factors (1). This decision will influence adjustment strategy and, consequently, the adjusted estimates. Including intermediates in the models would lead to overadjustment and would certainly not be correct. One example is parental income and parental death. We had data on both, but did not include them in the analysis since they could plausibly be regarded as consequences and not causes of disability. On the other hand, we assumed that low parental educational attainment could be regarded a risk factor *for* rather than a consequence *of* disablement; we therefore included parental educational attainment in the analysis.

The impact of early social disadvantage on adult social function is high (15). The adjusted estimates in the present study indicate a modest impact of parental disability for most study outcomes with the exception of own disability pension. Given the 10% of index persons with parental disability had had the same hazard of own disability pension as the 90% without parental disability, the total level of disability pension in young adult age (18-25 years) would have been 13% lower than what was actually observed for both women and men. This indicates that chronic disease in

Table 4. Gender-specific associations between maternal and paternal disability pension, and maternal and paternal disability pension within specific age strata of the index person, and index person's own disability pension during attained age 18-25 years, in 609 347 subjects, born in 1967-1976, who were alive, national residents, and not recipients of disability pension throughout the calendar year of their 17th birthday.

			Number with	Proportion	Crude		Adjusted*	
Category	N	%	outcome	with outcome	Ratio	95% CI	Ratio	95% CI
Women								
Maternal disability pension								
No	280 091	94.1	2517	0.009	1	Reference	1	Reference
Yes	17 411	5.9	524	0.030	3.38	3.08–3.72	2.01	1.81–2.22
If yes, by age of index person								
0-6 years	2139	0.7	100	0.047	5.31	4.35–6.48	3.14	2.55–3.85
7-12 years	4770	1.6	137	0.029	3.23	2.72–3.83	1.68	1.40–2.00
13-17 years	10 502	3.5	287	0.027	3.07	2.71–3.46	1.94	1.71–2.20
Paternal disability pension								
No	282 544	95.0	2682	0.009	1	Reference	1	Reference
Yes	14 958	5.0	359	0.024	2.55	2.28–2.85	1.70	1.51–1.91
If yes, by age of index person								
0-6 years	2302	0.8	88	0.038	4.08	3.30–5.05	2.88	2.30–3.60
7-12 years	4343	1.5	105	0.024	2.57	2.12–3.12	1.47	1.20–1.80
13-17 years	8313	2.8	166	0.020	2.12	1.81–2.48	1.54	1.31–1.81
Men								
Maternal disability pension								
No	293 458	94.1	2939	0.010	1	Reference	1	Reference
Yes	18 387	5.9	576	0.031	3.17	2.90–3.46	1.63	1.48–1.79
If yes, by age of index person								
0-6 years	2235	0.7	101	0.045	4.60	3.77–5.61	2.18	1.78–2.67
7-12 years	4901	1.6	186	0.038	3.85	3.32–4.46	1.73	1.49–2.02
13-17 years	11 251	3.6	289	0.026	2.59	2.29–2.92	1.45	1.28–1.64
Paternal disability pension								
No	296 452	95.1	3009	0.010	1	Reference	1	Reference
Yes	15 393	4.9	506	0.033	3.28	2.99–3.61	2.17	1.96–2.41
If yes, by age of index person								
0-6 years	2368	0.8	122	0.052	5.20	4.34–6.24	2.94	2.42–3.56
7-12 years	4549	1.5	157	0.035	3.44	2.93–4.04	2.19	1.86–2.59
13-17 years	8476	2.7	227	0.027	2.67	2.33–3.05	1.93	1.68–2.21

* Adjusted for year of birth, geographical region, birth order, maternal marital status according to index person's age, equality in parents' number of children, maternal and paternal age at index person's birth, maternal and paternal educational attainment, and childhood disease benefit

childhood (18) is a more important cause of disability in young adult age.

Some caution is warranted when interpreting these results. It is important to recognise that the results at its best is valid in a context that not necessarily were true in another place and another time, for example if macro level societal conditions were entirely different. The results are, however, a reminder that many phenomena that we try to study and understand in contemporary settings and cross sections of time, in reality have long lasting roots. This seems to be the case for educational attainment, work participation, disability pension and sickness absence. We believe it would be wise to include this knowledge when planning research activities as well as preventive action.

ACKNOWLEDGEMENTS

The Research Council of Norway supported this work. We thank Ole-Henrik Edland at the Medical Birth Registry of Norway and Tove Bergseteren at Statistics Norway for file preparations, and Ola Thune at the National Insurance Administration for file preparations and linking.

REFERENCES

1. Kuh D, Ben-Shlomo Y, Lynch J, Hallquist J, Power C. Glossary: life course epidemiology. *J Epidemiol Community Health* 2003; **57**: 778-83.
2. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol* 2002; **31**: 285-93.
3. Kuh DJL, Wadsworth MEJ, Yusuf EJ. Burden of disability in a post war birth cohort in the UK. *J Epidemiol Community Health* 1994; **48**: 262-9.
4. Jefferis BJMH, Power C, Hertzman C. Birth weight, childhood socioeconomic environment, and cognitive development in the 1958 British birth cohort study. *Br Med J* 2002; **325**: 305-8.
5. Strauss RS. Adult functional outcome of those born small for gestational age: twenty-six-year follow-up of the 1970 British Birth Cohort. *J Am Med Assoc* 2000; **283**: 625-32.
6. Kinge FO, Bjerkedal T. [Omfang av uførepensjonering etter skolebakgrunn] The extent of disability pension by school background. *Tidsskr Nor Lægeforen* 1994; **114**: 2139-42.
7. Lindén V. Social causes of permanent disability. *Acta Sociomed Scand* 1970; **2**: 55-63.
8. Upmark M, Lundberg I, Sadigh J, Bigert C. Conditions during childhood and adolescence as explanations of social class differences in disability pension among young men. *Scand J Public Health* 2001; **29**: 96-103.
9. Upmark M, Thundal KL. An exploratory, population-based study of female disability pensioners: the role of childhood conditions and alcohol abuse/dependence. *Scand J Public Health* 2002; **30**: 191-9.
10. Brun C, Bøggild H, Eshøj P. [Socioøkonomiske risikoindikatorer for førtidspension blandt ervervsaktive dansker: en registerbaseret kohorteundersøgelse for perioden 1994-1998]. Socio-economic risk indicators for disability pension within the Danish workforce: a register based cohort study from 1994 to 1998. *Ugeskr Laeger* 2003; **165**: 3315-9.
11. Hasle H, Jeune B. [Opvækstvilkårenes betydning for førtidspensionering: En case-kontrolundersøgelse blandt specialarbejdere]. Childhood conditions and disability pension. A case-control investigation among general workers. *Ugeskr Laeger* 1989; **151**: 1926-8.
12. Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-up of 62 000 people in a Norwegian county population. *Int J Epidemiol* 2002; **31**: 1183-91.
13. Bjerkedal T, Thune O. [Grunn- og hjelpestønad til barn – omfang og medisinske årsaker] Basic benefit and attendance benefit to children in Norway – prevalence and cause specific rates. *Tidsskr Nor Lægeforen* 1994; **114**: 1941–5.
14. Skov T, Deddens J, Petersen M, Endahl L. Prevalence proportion ratios: estimation and hypothesis testing. *Int J Epidemiol* 1998; **27**: 91-5.
15. Kristensen P, Bjerkedal T, Irgens LM. Birthweight and work participation in adulthood. *Int J Epidemiol* 2004; **33**: in press, advance access published online, doi:10.1093/ije/dyh111.
16. Wadsworth MEJ, Butterworth SL, Hardy RJ, Kuh DJ, Richards M, Langenberg C, Hilder WS, Connor M. The life course prospective design: an example of benefits and problems associated with study longevity. *Soc Sci Med* 2003; **57**: 2193-205.
17. Hallquist J, Lynch J, Bartley M, Lang T, Blane D. Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socio-economic positions and myocardial infarction in the Stockholm Heart Epidemiology Program. *Soc Sci Med* 2004; **58**: 1555-62.
18. Bjerkedal T. [Uførepensjonering i ung alder i Norge i årene 1976-96] Disability pensioning of 16 to 24-year olds in Norway from 1976 to 1996. *Tidsskr Nor Lægeforen* 1998; **118**: 2305-7.