

RESEARCH REPORT

Long term outcome after poliomyelitis in different health and social conditions

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Objective: To examine and compare the long term outcome after polio in an east European and a west European country with different access to rehabilitation and with different medical and social conditions.

Design and Setting: The patients who were acutely hospitalised for polio 1950–54 in the University Hospital in Bergen, Norway and 1958 in the University Hospital in Tartu, Estonia received the mailed questionnaire in the period between January 1998 and December 1998.

Patients: Patient files concerning 334 patients hospitalised in Tartu and 243 patients hospitalised in Bergen were obtained; of these 128 Estonian and 148 Norwegian patients were re-examined.

Main results: Despite more pronounced disability in the acute stage, significantly more Norwegian patients were working full time and part time in 1998 ($p < 0.0001$) and also through the period 1958–1998. In both countries, 30% of patients had manual work and 18% changed profession during their career. Low income (below 50% of national average) was reported by 73% of Estonian and 35% of Norwegian patients ($p < 0.0001$). Except for the odds ratio for muscular pain of 1.89 (95%CI = 1.14 to 3.14) for Norwegian patients, new symptoms indicating late progression did not differ. Norwegian patients were more independent with significantly less need for assistance in housekeeping ($p = 0.02$), whereas the use of orthopaedic devices did not differ.

Conclusions: The long term outcome after polio is different in eastern and western Europe. Access to continuous rehabilitation seems to maintain physical independence in polio patients, improves their ability to earn their own income, and lessens the need for disability pensions.

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Poliomyelitis (polio) may cause various clinical symptoms in patients, from flu-like illness to pronounced paralysis with potentially lethal respiratory failure. The disease occurred in epidemics and was a challenge for health services worldwide. After the introduction of vaccination in the 1950s, the epidemics disappeared from most countries and polio became a rare disease. However, millions of polio survivors who had acquired a physical handicap were in need of rehabilitation and clinical follow up. The organisation of this rehabilitation depended on local medical resources, health policy, and national socioeconomic conditions.

Patients with polio may experience progression with new symptoms decades after the acute disease. The symptoms include further development of muscular weakness in combination with muscular atrophy, pain, and fatigue^{1–3} and are frequently reported among patients despite regular rehabilitation and follow up.^{2,4} There is no cure for preventing late symptoms and little is known to what degree rehabilitation influences the long term outcome.

The aim of this study was to compare the long term polio outcome among patients living under different medical and social conditions. In Norway, the polio patients received systematic neurorehabilitation from the acute stage with clinical follow up,⁵ while in Estonia as in most eastern European countries, the access to rehabilitation was limited^{6–9} and follow up was non-existent. The general health conditions are different with a highly ranked disability adjusted life expectancy in Norway (71.7 years in 1999) in contrast with a lower rank in Estonia (63.1 years in 1999).¹⁰ The social conditions differ with a comprehensive welfare system in Norway and a less well developed pension system in Estonia, rearranged after the collapse of the former Soviet Union.

METHODS

Patients

The last polio epidemics in Norway took place 1950–54 and in Estonia in 1958, a year before vaccination was introduced in parts of the Soviet Union.^{11,12} In Norway, 5553 patients (1395 non-paralytic and 4158 paralytic cases) were registered between 1950 and 1954.¹³ In Estonia, 565 cases were registered in 1958, 418 of them with paralytic polio.¹⁴

This study was started in 1998 and included patients diagnosed with acute polio and hospitalised during the last polio outbreaks at two university hospitals in Norway (Bergen) and Estonia (Tartu). The diagnosis of polio was based upon typical clinical symptoms and the laboratory examination of cerebrospinal fluid. Stool culture examination of poliovirus was not available in this period in Estonia and in Norway. There was access to treatment with assisted ventilation in both hospitals. Vaccination was introduced in 1957 in Norway and in 1959 in Estonia.^{11,15} Both hospitals currently serve about one million people as referral hospitals and 350 000 people as emergency and local hospitals.

In Bergen, 243 patients were hospitalised for acute polio 1950–54, 16 of them (6.6%) died of respiratory complications during the acute stage. Another 30 patients died from non-polio causes in the period of 1954–1998. A total of 175 of the remaining polio patients (89%) were identified and received the questionnaire by mail. Altogether 148 of them responded and were included (fig 1). In Tartu, 334 patients were hospitalised in 1958, 25 of them (7.5%) died of acute respiratory complications. Twenty four patients died later. Altogether 193 of the remaining polio patients (68%) were identified and received the mailed questionnaire and 128 of them responded and were included in this study. The acute polio did not differ in patients identified and not identified in any of the countries; nor did it differ in responders and

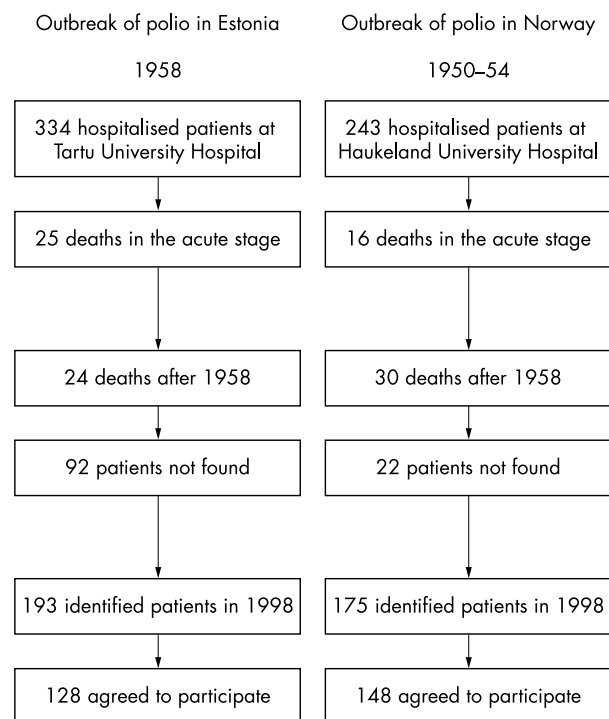


Figure 1 Flow chart for inclusion to the study.

non-responders. One reminder was mailed to the non-responders in both countries. All responders were offered further clinical examination.

Questionnaire

The patients were interviewed with an identical questionnaire. The information included confirmatory data about the acute disease and the persisting paresis, as well as the development of any new muscular weakness, muscular pain, and fatigue with registration of the year when new symptoms developed. The patients with acute transitory findings had paretic muscular involvement and symptoms of meningitis with raised mononuclear cell number in the spinal fluid during the hospitalisation, but had clinically fully recovered at discharge from the hospital. Non-polio diseases were specifically asked for; childhood diseases, cardiovascular, respiratory,

neurological, rheumatological, and endocrinological disorders as described previously.¹⁵

Height and weight were registered and body mass index calculated (weight in kilograms divided by the square of height in metres). Lifestyle data concerning physical exercise and smoking habits were collected. Need of orthopaedic devices and assistance in housekeeping were registered as a measure for individual independence. Marital status, number of children, employment (profession, change of profession, full time or part time job, unemployed, or applying for job) and present income were recorded. Income was grouped as more or less than 50% of average income in each country (low income). For the Norwegians, low income was defined as less than Nkr 150 000 per year, whereas for the Estonians it was less than EEKkr 24 000 per year.¹⁶⁻¹⁷ Patients receiving age pension and disability pension were recorded. Only patients with polio as the cause of pension were included.

Regional ethical committees in both countries approved of the study.

Statistical analysis

We use χ^2 and Fisher's exact tests to compare distribution of demographic and clinical characteristics between Estonian and Norwegian polio patients. The two samples *t* test was applied when comparing mean values of continuous variables. Separate analyses were carried out for patients with transitory findings during the acute disease and for those with persistent pareses.

The odds for late polio symptoms in the Estonian compared with Norwegian population were calculated in a multiple logistic regression analysis. Adjustment was made for sex, age, and reported rheumatological, cardiovascular, respiratory, and non-polio neurological diseases, in addition to initial diagnosis (transitory findings or persistent paresis). To examine whether the relative difference in odds of a particular symptom between the two populations differed according to initial diagnosis (transitory findings or persistent paresis), an interaction term was included in the statistical model.

Because of missing data the number of patients included in the different analyses varied from 257 to 276.

RESULTS

Clinical and demographic characteristics

Significantly more Estonian than Norwegian patients had only transitory findings in the acute phase (table 1). This

Table 1 Clinical and demographic characteristics of Estonian and Norwegian polio patients

Characteristic	Estonian patients (n=128)	Norwegian patients (n=148)	p Value*
Clinical			
Persistent paresis n (%)	44 (34)	85 (57)	<0.001
Transitory findings n (%)	84 (66)	63 (43)	
Demography			
Age, (y) mean (SD)	56 (10)	55 (9)	0.9
Female sex (%)	56	55	0.7
Marital status no (%)			
Married	82 (64)	106 (72)	0.2
Separated, divorced, widowed	14 (11)	10 (7)	
Never married	32 (25)	32 (22)	
Lifestyle factors			
Body mass index, mean (SD)	24.9 (5.0)	24.7 (4.4)	0.1
Current smoking no (%)	31 (24)	50 (34)	0.09
Physical exercise n (%)			
Regularly	6 (5)	28 (19)	<0.001
Sometimes	46 (36)	60 (41)	
Never	75 (59)	58 (40)	

* χ^2 Test for difference in distribution of categorical variables. Two sample *t* test for difference in mean values of continuous variables.

Table 2 Employment status among Estonian and Norwegian patients in 1998

	Estonian patients n (%)			Norwegian patients n (%)		
	All	Transitory findings	Persistent paresis	All*	Transitory findings*	Persistent paresis†
Full time job	51 (37)	38 (43)	13 (30)	82 (54)	38 (61)	44 (49)
Part time job	6 (4)	4 (9)	2 (5)	26 (17)	13 (21)	13 (14)
Seeking for job/unemployed	11 (8)	5 (6)	6 (14)	3 (2)	2 (3)	1 (1)
Disability pension	42 (30)‡	17 (21)‡	23 (52)‡	26 (17)§	6 (10)	20 (22)§
Age pension	28 (20)‡	25 (23)‡	4 (9)‡	15 (10)§	3 (5)	12 (13)§

* $p < 0.0001$ for the comparison with the Estonian patients. † $p < 0.001$ for the comparison with the Estonian patients. ‡10 patients received both pensions and were employed, six with persistent paresis and four with transitory findings. §5 patients with persistent paresis received both pensions and were employed.

included hospitalised cases with aseptic meningitis or peripheral paresis, or both, and from a geographical area with diagnosed paralytic polio cases. The patients with transitory findings were apparently fully recovered at the discharge from hospital.

Fewer Estonian than Norwegian patients exercised regularly. Both groups had body mass index indicating moderate overweight (table 1). Smoking status and concomitant disease profile did not differ between the Estonian and Norwegian patients. In both groups, most patients were married, and had on average 1.7 (in Estonia) and 2.1 (in Norway) children, corresponding to the fertility rates in the two countries in 1998.¹⁸

Demographic data were the same in groups with persisting paresis or transitory findings (data not shown).

Employment, pensions, and income

Significantly more Norwegian than Estonian patients were working full time in 1998 (table 2). The difference was highly significant also for the separate groups with transitory findings and persistent paresis. In addition, a greater proportion of the Norwegian patients had part time jobs ($p < 0.0001$). In contrast, more Estonian patients were unemployed or received disability and age pensions (table 2). This was true for both subgroups; with and without persistent paresis.

The difference between the two countries in awarding disability pensions occurred between 1960 and 1979 (fig 2). In this period, four Norwegians and 24 Estonians received disability pensions. From 1980, a similar proportion of patients from both countries received new disability pension. The subgroups with transitory findings and persistent paresis showed the same trend.

Fatigue occurred more frequently among unemployed than employed patients in both countries; 63% compared with 37%

($p = 0.004$) in Estonia and 69% compared with 37% ($p = 0.002$) in Norway. Among the Norwegian patients, new muscular weakness was significantly more frequent among unemployed patients; 51% compared with 86% ($p < 0.0001$), while in Estonia this difference did not occur. Muscular pain was reported in a similar proportion of employed and unemployed patients in both countries.

The distribution of professions was similar among the Estonian and Norwegian patients with the largest group employed in trade and office (39% and 35% respectively). Surprisingly, 36% of Estonian and 31% of Norwegian patients had heavy manual work. The same percentage of Estonian and Norwegian patients (18%) reported change of profession because of health problems.

Low income, less than 50% of the national average, was reported by 73% of Estonian and 35% of Norwegian patients ($p < 0.0001$). For patients with persistent paresis, 56% of Norwegian and 76% of Estonian patients had low income. Only five (8%) of the Norwegian patients with transitory findings had low income, compared with 59 (70%) of Estonian patients. In Estonia, 58 of 83 patients (70%) with low income received pension or were unemployed while in Norway 10 of 49 (20%) ($p < 0.0001$).

Occurrence of late polio related symptoms

A similar percentage of the patients in Estonia and Norway reported development of new muscular weakness, 52.3% compared with 59.9% (table 3). Fatigue was reported by 51.6% compared with 45.5%. Significantly more Norwegian than Estonian patients reported new muscular pain (49.9% v compared with 34.4%, $p = 0.01$). This difference could be explained by the subgroup with persistent paresis, where a similar difference was observed (58.5% compared with 38.6%, $p = 0.03$).

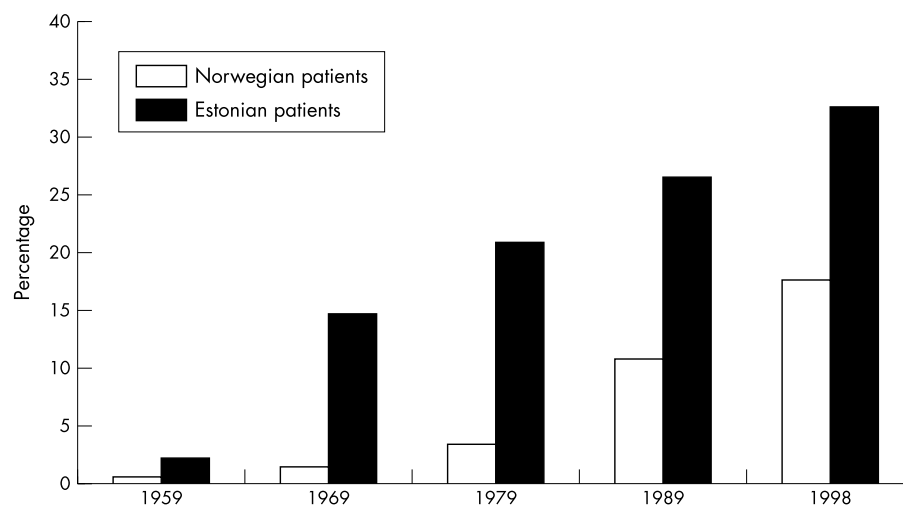


Figure 2 Percentage of Estonian and Norwegian patients on disability pension in 1959, 1969, 1979, 1989, and 1998.

Table 3 Odd ratio for development of new late symptoms after polio among Norwegian compared with Estonian patients

	New muscular weakness			New muscular pain			Fatigue		
	N (%)	OR (95% CI)*	p	N (%)	OR (95% CI)*	p	N (%)	OR (95% CI)*	p
Total									
Estonian	67 (52.3)	1.00		44 (34.4)	1.00		66 (51.6)	1.00	
Norwegian	85 (59.9)	1.13 (0.66 to 1.93)	0.65	69 (48.9)	1.89 (1.14 to 3.14)	0.01	66 (45.5)	0.70 (0.41 to 1.17)	0.17
Transitory findings									
Estonian	38 (45.2)	1.00		27 (32.1)	1.00		38 (45.2)	1.00	
Norwegian	24 (41.4)	0.90 (0.44 to 1.82)	0.77	21 (35.6)	1.22 (0.59 to 1.49)	0.22	24 (38.7)	0.65 (0.32 to 1.32)	0.24
Persistent paresis									
Estonian	29 (65.9)	1.00		17 (38.6)	1.00		28 (63.6)	1.00	
Norwegian	61 (72.6)	1.54 (0.68 to 3.46)	0.3	48 (58.5)	2.34 (1.09 to 5.03)	0.03	45 (54.2)	0.74 (0.34 to 1.63)	0.46

*Results adjusted for age, gender, type of findings (transitory findings or persistent paresis) and for reported additional neurological, rheumatological, cardiovascular and respiratory diseases. An interaction between type of findings and patient groups (Estonian-Norwegian) is included to the adjusted multiple regression analysis.

Key points

- More Norwegian than Estonian patients were employed 50 years after their acute polio despite having more pronounced disability in the acute stage.
- Norwegian polio patients needed less personal assistance than Estonian patients.
- New symptoms indicating late polio progression occurred in both populations.

The odds ratio (OR) for experiencing new muscular pain was significantly higher for Norwegian patients (1.89, $p=0.01$) and particularly in the subgroup with persistent paresis (2.34, $p=0.03$). Additional adjustment for physical activity was made, as this factor differed in Norwegian and Estonian patients (table 1), but the OR remained significantly higher for the Norwegian patients and the subgroup with persistent paresis. The OR did not differ for new muscular weakness and fatigue in the Norwegian compared with the Estonian patients.

Individual independence

Twenty six Norwegian and 28 Estonian patients with persistent paresis used orthopaedic devices ($p=0.32$), including six Norwegians and eight Estonians with wheelchair and four Norwegians and 10 Estonians with an orthosis. Thirteen Norwegian and 13 Estonian patients reported use of walking aid. Eight per cent of the Norwegian and 17% of the Estonian patients ($p=0.02$) received housekeeping assistance. None of the patients lived in institutions.

DISCUSSION

The benefit of clinical follow up including regular physiotherapy after polio has not previously been examined, but the long term value of neurorehabilitation has been demonstrated in other diseases causing physical disability.^{19, 20} The largest and youngest populations of polio victims are living in countries with few economical and social resources.²¹ The impact of increased individual disability under such circumstances is even more explicit.^{22, 23} Optimal health conditions are crucial for the person, but also to prevent social problems caused by disability and old age^{24, 25} and so it is important to identify factors that prevent late disability.

We found that more Norwegian than Estonian patients were employed and that this difference was observed from short time after the acute polio until the end point of the study in 1998. The observation was unexpected because a higher fraction of the general population receives disability pension

in Norway than in Estonia; 5.7% in Norway compared with 4.0% in Estonia in 1998.¹⁶⁻¹⁸ On the other hand, the unemployment in Estonia is 2.4 times higher than in Norway; 10.2% of the general population in Estonia compared with 3.0% in Norway in 1998.¹⁶⁻¹⁸ The low unemployment rate may encourage Norwegian employers to keep employees with physical disabilities. Most importantly, the higher employment rate among Norwegian polio patients may be explained by their scheme for regular rehabilitation keeping them at an optimal functional level, whereas the patients have had limited access to such treatment in Estonia. Although the Soviet social system guaranteed employment for everyone, polio patients did not obtain the functional level necessary for keeping their jobs. Interestingly, rearrangement of the social system and change to a market economy in Estonia in 1991 did not make any difference for the rate of polio patients with disability pension. The unemployment among Estonian polio patients in 1998 was similar to the national average,¹⁸ and should be considered as an effect of market economy as unemployment did not exist during the Soviet period. In Norway, only three persons claimed seeking for jobs, in line with the average for the general population.¹⁸ Both in Estonia and Norway about one third of the polio patients had manual work despite their history of physical handicap. The high number of patients with heavy work may explain why 18% changed profession because of health problems during their career. The higher proportion of age pensioners among Estonians is explained by younger age for such pension in Estonia (67 years for men and women in Norway compared with 62.5 years for men and 57.7 years for women in Estonia in 1998).¹⁸

There was a significant difference in income profile between Estonian and Norwegian patients, 73% of Estonian patients versus only 28% of Norwegian patients had an income lower than 50% of the national average. Higher employment rate and better income via pensions in Norway are two main explanations. An important underlying cause is differences regarding social politics and resources available in the two societies. Physical disability can obviously limit choices in the labour market and cause low income as demonstrated in a birth cohort in the UK.²⁶

Regarding the late symptoms of polio, the same percentage of patients in Estonia and in Norway reported the development of new muscular weakness and fatigue when examined by identical methods. New muscular pain occurred more often in Norwegian patients, but the total frequency of new symptoms were for both groups similar to previous studies on patients with polio sequels in western Europe and USA.^{2, 3, 27} However, these subjective symptoms were more frequent among the patients in both countries than in the general

population group.¹⁵ Also the patients with transitory findings only during the acute polio reported more symptoms than the general population today. New symptoms among such patients have been reported before.^{15, 28} The subclinical motor neuron damage during the acute polio in combination with the normal aging process explain these symptoms.^{15, 28} In the multiple regression analysis, we observed wide confidence intervals and OR differences with no significance. This is explained by the rather low statistical power of the study.

Despite their awareness about the possibility for new progression, Norwegian patients remained employed for decades after the acute disease. Obviously information about sequels does not provoke the development of such symptoms. Fatigue was reported more frequently by patients who received pensions and were not employed. Thus, fatigue interferes with the daily activities of polio patients in line with two previous studies.^{29, 30}

We did not find significant differences regarding use of orthopaedic devices, although accessibility and financing have been easier in Norway than in Estonia.⁹ The Norwegian patients were more independent in domestic life and needed less household assistance. As Estonian patients have to finance assistance themselves and housekeeping assistance has been unusual in the general population, the explanation for this difference has to be that they are more dependent and have a lower functional level than the Norwegians with the same physical disability. Better availability for adjustments of homes and buildings for people with physical handicaps explain in part less need for assistance in Norway. The impact of physical disability depending on social conditions has been demonstrated before.²²

The fraction of included patients in Estonia and in Norway was different. In Estonia, identification and tracing of patients from 1958 was difficult because of differences and discontinuation in registration in the Soviet and the independent era. Also the response rate among the identified patients was lower in Estonia. Unawareness about possible late polio sequels may be one of the reasons.

This study shows that a rehabilitation scheme with continuous physiotherapy and clinical follow up has caused more beneficial outcome for patients with previous polio. The social and medical arrangements maintain polio victims physical independence and improves their ability to earn own income with subsequent better individual economical conditions and less need for disability pensions.

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