



# Serotype 23F as risk factor for pneumococcal meningitis in adults in Germany 2001-2006

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## Introduction

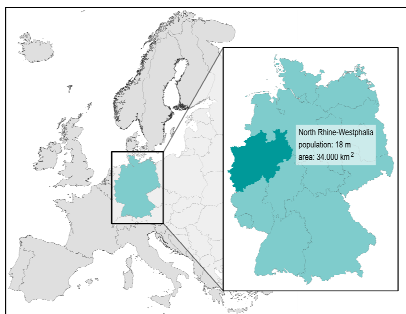
Pneumococcal meningitis is a subgroup of invasive pneumococcal disease (IPD) with a case-fatality rate of up to 50 percent and long-term sequelae in up to 60 percent of cases in adults. We wanted to determine risk factors for pneumococcal meningitis.

## Materials and Methods

We conducted a prospective population-based laboratory study of invasive pneumococcal disease in North-Rhine-Westphalia, Germany from February 2001 until August 2006. Inclusion criteria for this study were:

- age of the patient at the onset of disease 16 years or older
- invasive disease confirmed by *S. pneumoniae* isolation from a normally sterile body site (i.e. blood or CSF)
- patient living in the area of North Rhine-Westphalia, Germany

All isolates (1174: 1043 from bacteremia, 131 from meningitis) underwent serotyping and susceptibility testing. Data were analysed using multiple logistic-regression. Selected strains underwent MLST and results were compared with data from the mlst.net database (www.mlst.net).



## Results

Of 1174 strains 555 (47,3%) were isolated from women, 608 (51,8%) were isolated from men, in 11 cases the gender of the patient could not be determined. 405 strains (34,5%) were isolated from patients 16-59 years old, 769 (65,5%) strains were isolated from patients ≥60 years of age. 176 (15%) cases were due to serotype 14, 74 (6,3%) cases were due to serotype 1, 68 (5,8%) were due to serotype 23F.

Variable	Adjusted OR (95% CI)	p-value
Age	0.50 (0.34 - 0.73)	<0.001
Gender	1.54 (1.05 - 2.26)	0.03
Serotype		0.02
14	0.87 (0.5 - 1.52)	0.63
1	0.24 (0.07 - 0.84)	0.03
23F	2.03 (1.06 - 3.90)	0.03

Table1: odds ratios of multivariate logistic regression

Serotype	Material	No	No of different MLST
1	Blood	6	1 (st306)
	CSF	2	1 (st306)
23F	Blood	21	8
	CSF	8	5

Table2: MLST distribution of randomly chosen German isolates

Serotype	Material	No	No of different MLST
1	Blood	102	36*
	CSF	123	28*§
23F	Blood	132	89#
	CSF	95	64#&

Table3: Analysis of MLST distribution of samples submitted to mlst.net (\*29 different countries, §e.g. st303 49x, st217 32x, st306 4x, #38 different countries, &e.g. st81 21x)

## Results

The analysis of all st306 submitted to mlst.net showed that all 38 isolates from 12 different countries (Canada, Czech Republic, Denmark, France, Germany, Hungary, Norway, Poland, Spain, Sweden, Switzerland, USA) belonged to serotype 1.

## Conclusions

1. Age, serotype, serotype 23F and gender are independent risk factors for the development of pneumococcal meningitis.
2. Older age and serotype 1 are inversely related with pneumococcal meningitis.
3. The MLST distribution of German 23F strains is very variable, whereas all serotype 1 isolates analysed belonged to a single sequence type (st306).
4. The worldwide MLST distribution of serotype 1 strains is as variable as expected. The variability of the MLST distribution of 23F strains seems to be even more variable.
5. St306 is unique for serotype 1 strains.
6. Non-invasiveness of serotype 1 strains into the subarachnoidal space might be a regional phenomenon and due to st306.