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Otitis media history, surgery and allergy in 60-year perspective: A population-based study

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ABSTRACT

Objectives: To assess the relationship between recurrent otitis media (OM), OM surgery and allergy in a 60-years perspective in the general population.

Methods: A cross-sectional questionnaire study of 40,000 randomly selected Norwegians aged 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75 and 80 years stratified by age and gender in 2005, i.e. each age group 30–60 years included 2000 and the remaining age groups 1000 persons of each gender. Main outcome measures were recurrent childhood OM, childhood myringotomy, ventilation tubes or adenoidectomy and lifetime allergy.

Results: The prevalence of recurrent OM was 24.3% ($n = 4823$) and OM surgery 12.4% ($n = 2499$). An increase in the proportion of OM surgery by age cohort was found, with the highest surgery rate of 0.52 for the 1955 age cohort, followed by a gradual decrease until the 1980 age cohort, when surgery stabilized at 0.42. Recurrent OM and OM surgery was more common in respondents with allergy. Among the latter, the probability for OM surgery was almost threefold when the age cohort 1945 was compared to 1920, OR_{adj} at 2.95 (1.59–5.48). The latter tendency remained strong until 1965. Among non-allergics, the increase in surgery probability by age cohort showed the same tendency, but the relationship was less strong than for those with allergy.

Conclusions: Despite a twofold increase in recurrent OM and OM surgery from 1925 to 1945, the proportion of OM and OM surgery have been stable since 1945. Our findings suggest a shift in clinical practice, most likely indicating a change in surgery from acute infections to otitis media with effusion (OME).

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1. Introduction

The disease entity otitis media (OM) has been subject to huge changes since the beginning of the 20th century, when infectious diseases dominated the ear-nose and throat (ENT) field [1,2]. Acute otitis media (AOM) accounted for 8.5% of all hospitalizations, with a mean hospital stay of 26 days [1,3]. Myringotomy and cortical mastoidectomy were common, and the ENT hospital beds during the first part of the century was filled with patients with OM and its complications [1,2]. The introduction of antibiotics in the 1930s completely changed the severity of the disease, with a significant reduction of the major

complications to AOM [2,3]. Even today complications to AOM are few, and current efforts aims at minimizing the use of antibiotics [4,5].

Following the introduction of antibiotics, attention was drawn to the emergence of otitis media with effusion (OME); ‘glue ear’ [6]. OME treatment also has changed considerably the past century, from adenoidectomy to a wide use of tympanostomy tubes re-introduction in 1954 [1,2,7,8]. In 1929 it was suggested that allergy may contribute to the development of glue ear [9]. Despite considerable research effort, however, the aetiological role of allergy is still unclear [9–12].

Today, surgery for OM has changed from a life-saving procedure prior to the introduction of antibiotics to a more restrictive surgical approach for OME [13–15]. The aim of the present study was to assess the relationship between recurrent OM, OM surgery and allergy in an age-cohort of participants born in the period 1925 to 1985.

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2. Material and methods

2.1. Sampling and representativeness

An age and gender stratified random sample of 40,000 persons aged 20–80 years old were drawn by the National Population Register. Each of the ages 30, 35, 40, 45, 50, 55 and 60 years included 2000 persons of each gender, while the remaining ages included 1000 persons of each gender. The participants were residing in Akershus, Hedmark or Oppland County in Norway. The sample size was reduced to 38,871 because of error in the address list ($n = 1024$), multihandicap ($n = 4$), dementia ($n = 23$), insufficient Norwegian language skills ($n = 3$) and deceased ($n = 75$). The three Counties have both rural and urban areas, and Akershus County is situated in close proximity to Oslo. Data from Statistics Norway has shown that the sampling area was representative for the total Norwegian population regarding age, gender, marital status and level of education. There was equal employment rate, but employment in trade, hotel/restaurant and transport were overrepresented, while industry, oil and gas and financial services were underrepresented in the sampling area as compared to the total Norwegian population.

2.2. Questionnaire

All participants received a mailed questionnaire with a standard letter containing information about the project. Apart from ensuring confidentiality and emphasising the importance of participation, it was stated that the object was to study sleepiness during daytime. Non-responders received a second mail. Electronic or postal return of the questionnaire was optional. The outcomes of interest for the present study were OM, OM surgery and allergy and the following 3 questions were used: “Have you had recurrent OM as a child?”, “Do you have/have you had allergy?” “If yes, was myringotomy, ventilation tube insertion or adenoidectomy performed?” Only respondents who answered yes to the question on recurrent OM and received OM surgery were categorized as having received OM surgery. There was no option to answer I do not know or I do not remember. Only questions on childhood surgery for otitis media, information on

childhood pharmaceutical treated was not included in the questionnaire.

2.3. Statistical analyses

The lifetime prevalence was measured as the proportion of subjects who reported recurrent episodes of OM and OM surgery. Chi-square tests and logistic regression modelling with 5% level of significance were used. The association between recurrent OM and OM surgery were estimated as odds ratios (ORs) and 95% confidence intervals using logistic regression modelling in SPSS 16.0. In our binary logistic regression model, history of OM and OM surgery was used as dependent variables and year of birth/age cohort, gender and history of allergy were independent variables.

2.4. Ethical issues

The project was approved by The Regional Committees for Medical Research Ethics and the Norwegian Social Science Data Services.

3. Results

3.1. Recurrent

The overall response rate was 54.5% (21,177/38,873), and it was significantly higher among women than men ($n = 11,120$ vs. $n = 10,057$; $p < .001$). The response rate increased steadily from age 20 years to age 65 years, and slowly declined in the elder age groups. Among responders the first, second and electronic questionnaire were replied by 64.9%, 26.8% and 8.3%, respectively. The electronic version was replied by significantly more men than women (men 11.6% vs. women 5.3%; $p < 0.001$). Complete information on childhood OM, OM surgery and lifetime allergy was received by 98.4%, 96.0% and 95.0%, respectively.

The sample characteristics are presented in Table 1. The prevalence of lifetime allergy was 32.6% ($n = 6564$), recurrent OM 24.3% ($n = 4823$) and OM surgery 12.4% ($n = 2499$). The proportion of OM surgery by recurrent OM and age cohort is shown in Fig. 1. A gradual increase in surgery rate from 1925 was found, with a peak

Table 1
Distributions of selected characteristics of the sample.

	Allergy $N = 6564$ (32.6%)		No allergy $N = 13,557$ (67.4%)		All ^a $N = 20,121$	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
Gender						
Males	2752	41.9	6771	49.9	9538	47.4
Females	3812	58.1	6786	50.1	10,583	52.6
Age cohort (age)						
1925 (80 years)	170	2.6	659	4.9	829	4.1
1930 (75 years)	231	3.5	805	5.9	1036	5.1
1935 (70 years)	272	4.1	889	6.6	1161	5.8
1940 (65 years)	336	5.1	917	6.8	1253	6.2
1945 (60 years)	667	10.2	1672	12.3	2339	11.6
1950 (55 years)	744	11.3	1568	11.6	2312	11.5
1955 (50 years)	795	12.1	1435	10.6	2230	11.1
1960 (45 years)	733	11.2	1332	9.8	2065	10.3
1965 (40 years)	721	11.0	1351	6.7	2072	10.3
1970 (35 years)	675	10.3	1130	8.3	1805	9.0
1975 (30 years)	664	10.1	964	7.1	1628	8.1
1980 (25 years)	284	4.3	427	3.1	711	3.5
1985 (20 years)	272	4.1	408	3.0	680	3.4
History of recurrent otitis media						
Yes	1869	28.9	2954	22.1	4823	24.3
No	4594	71.1	10,439	77.9	15,033	75.7
Otitis media surgery						
Yes	975	14.9	1524	11.2	2499	12.4
No	5589	85.1	12,033	88.8	17,622	87.6

^a Missing: recurrent otitis media 330, otitis media surgery 201, allergy 1056.

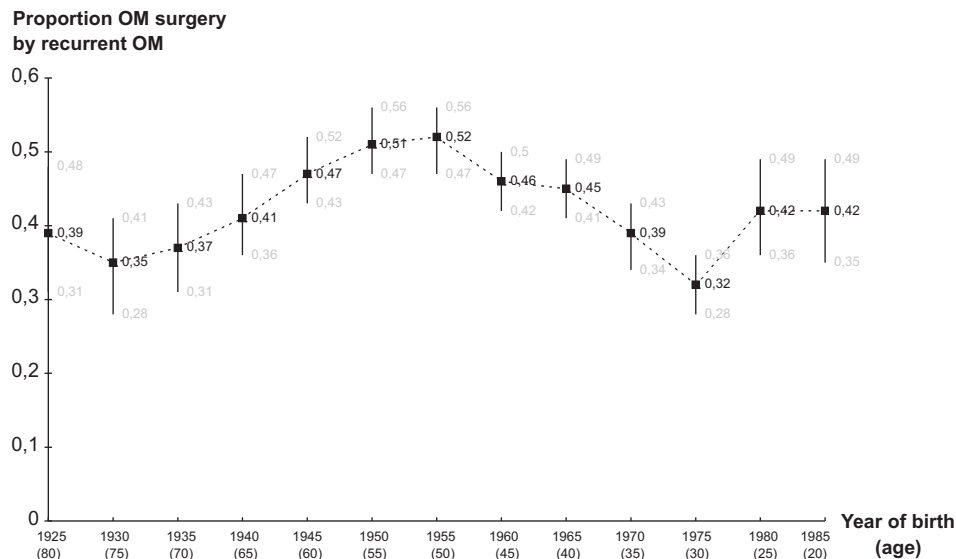


Fig. 1. The frequency distribution of otitis media (OM) surgery among those with recurrent OM by age cohort ($N = 5031$).

of 0.52 in age cohort 1955, followed by a gradual decrease until 1980, when surgery rate stabilized at 0.42 (Fig. 1). Gender figures for recurrent OM and OM surgery were 22.9% ($n = 2265$) and 11.9% ($n = 1195$) for males and 25.3% ($n = 2766$) and 12.8% ($n = 1426$) for females, respectively.

Allergy was reported by 28.9% ($n = 2752$) of men and by 36.0% ($n = 3812$) of women. The distribution of recurrent OM and OM surgery by allergy and age cohort in Fig. 2 shows that throughout the study period, recurrent OM and OM surgery was more common in respondents with allergy (Table 1). For allergic and non-allergic respondents, OM prevalence increased from 19.0% and 13.3% for those born in 1920 to 30.9% and 28.5% for those born in 1980. Corresponding figures for OM surgery were 7.1% among allergic and non-allergic 80 year olds and 16.5% and 12.5% for 20 year old allergic and non-allergics. Peak surgery rate was 18.4% in 1945 and 13.3% in 1950 for allergic and non-allergic respondents, respectively.

Table 2 shows the probability for recurrent OM and OM surgery by co-occurrence of allergy in a logistic regression model adjusted for age and gender. A steadily increasing age cohort effect was

found for recurrent OM when the younger age groups were compared to respondents born in 1925. The effect was somewhat stronger in those with allergy, adjusted odds ratios ranging from 1.32 to 2.55 (Table 2). Further, the corresponding probability for OM surgery was almost threefold when the age cohort 1945 was compared to 1920, OR_{adj} at 2.95 (1.59–5.48). The latter tendency remained strong until 1965. From 1970, the probability was reduced to approximately twofold (Table 2). Among non-allergics, the corresponding increase in surgery probability by age cohort showed the same tendency, but the relationship was less strong than for those with allergy (Table 2).

4. Discussion

Our population-based cross-sectional study including 21,177 persons aged 20–80 years found an increasing prevalence of recurrent OM, but stable OM surgery rates. The probability for OM surgery was increased among allergic as compared to non-allergic respondents in the younger age cohorts.

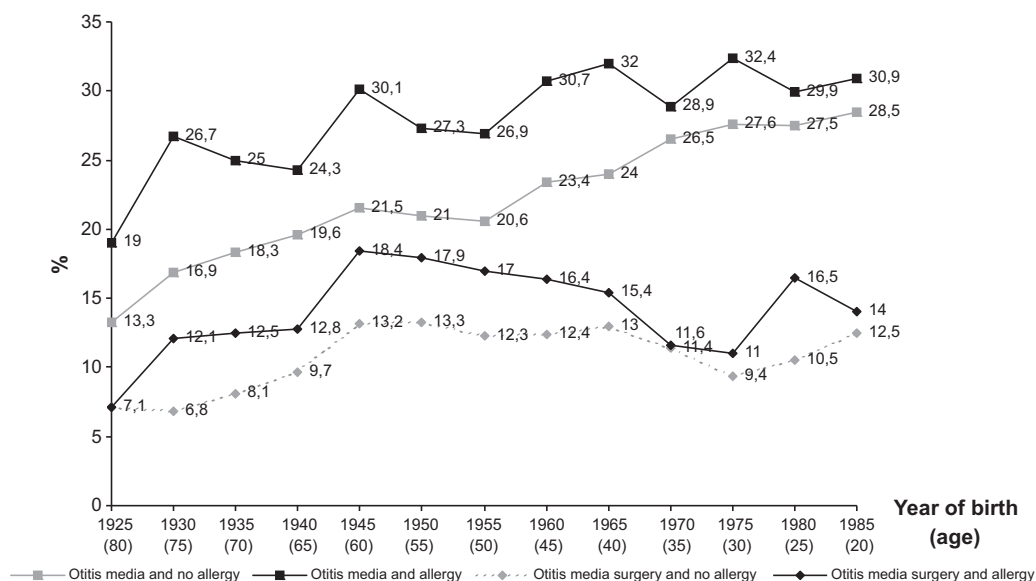


Fig. 2. The frequency distribution of recurrent otitis media and otitis media surgery by age cohort and allergy.

Table 2

Recurrent otitis media and otitis media surgery by co-occurrence of lifetime allergy analyzed with a logistic regression model adjusted for gender and age cohort.

		No allergy			Allergy		
		cOR	aOR	95%CI	cOR	aOR	95%CI
Recurrent otitis media							
Gender							
Males		Ref	Ref		Ref	Ref	
Females		1.08	1.04	(.96–1.13)	1.20	1.19	(1.07–1.33)
Age cohort							
(age)							
1925 (80 years)		Ref	Ref		Ref	Ref	
1930 (75 years)		1.32	1.32	(.99–1.75)	1.52	1.52	(.96–2.43)
1935 (70 years)		1.51	1.51	(1.15–1.99)	1.37	1.35	(.86–2.13)
1940 (65 years)		1.63	1.63	(1.24–2.14)	1.30	1.29	(.83–2.04)
1945 (60 years)		1.96	1.96	(1.53–2.51)	1.91	1.89	(1.26–2.82)
1950 (55 years)		1.84	1.83	(1.43–2.35)	1.69	1.68	(1.13–2.51)
1955 (50 years)		1.78	1.77	(1.37–2.28)	1.53	1.52	(1.02–2.24)
1960 (45 years)		2.05	2.05	(1.59–2.63)	1.71	1.72	(1.15–2.57)
1965 (40 years)		2.09	2.08	(1.62–2.68)	1.89	1.88	(1.26–2.80)
1970 (35 years)		2.90	2.27	(1.76–2.94)	1.58	1.58	(1.06–2.37)
1975 (30 years)		2.44	2.42	(1.86–3.14)	1.81	1.82	(1.22–2.72)
1980 (25 years)		2.38	2.36	(1.74–3.21)	1.64	1.63	(1.04–2.55)
1985 (20 years)		2.57	2.55	(1.87–3.46)	1.66	1.66	(1.06–2.60)
Otitis media surgery							
Gender							
Males		Ref	Ref		Ref	Ref	
Females		1.02	1.00	(.90–1.12)	1.16	1.16	(1.01–1.34)
Age cohort							
(age)							
1925 (80 years)		Ref	Ref		Ref	Ref	
1930 (75 years)		.96	.95	(.64–1.43)	1.82	1.82	(.90–3.69)
1935 (70 years)		1.15	1.15	(.78–1.68)	1.88	1.87	(.94–3.74)
1940 (65 years)		1.40	1.40	(.97–2.02)	1.93	1.92	(.99–3.75)
1945 (60 years)		1.98	1.98	(1.43–2.72)	2.98	2.95	(1.59–5.48)
1950 (55 years)		1.99	1.99	(1.43–2.77)	2.87	2.86	(1.54–5.30)
1955 (50 years)		1.82	1.82	(1.30–2.55)	2.69	2.69	(1.45–4.97)
1960 (45 years)		1.84	1.84	(1.31–2.58)	2.58	2.59	(1.39–4.80)
1965 (40 years)		1.94	1.94	(1.38–2.71)	2.40	2.38	(1.28–4.43)
1970 (35 years)		1.68	1.68	(1.18–2.38)	1.72	1.72	(.92–3.24)
1975 (30 years)		1.38	1.36	(.94–1.96)	1.63	1.63	(.87–3.08)
1980 (25 years)		1.53	1.53	(1.00–2.35)	2.61	2.60	(1.33–5.05)
1985 (20 years)		1.86	1.86	(1.22–2.82)	2.14	2.14	(1.08–4.22)

4.1. Methodological considerations

The size of the study should provide sufficient data for age and gender specific associations of OM, surgery and allergy. The response rate was fair and there were few missing values. We were not able to investigate whether responders and non-responders had a similar pattern of recurrent OM, OM surgery and allergy since we were not allowed to contact non-responders. However, similar replies to the first and second issued questionnaire as well as electronic responses suggest that responders and non-responders are not different.

There are limitations with the use of self-reports to measure recurrent OM in childhood. As the latter usually is not a disabling or life threatening disorder, recall bias is likely to occur if one asks about OM years ago. However, previous studies from both the UK and Norway have found retrospective OM self-reports to be a relative robust measure [16,17]. An advantage by our questionnaire-based survey is the elimination of consultation bias, i.e. not all people consult a GP or ENT specialist due to OM. Although the medical record has traditionally been seen as the “gold standard” for data collection in clinical research, self-reports may be more exhaustive for estimates of community based prevalence of OM [17]. Finally, we found the same age cohort trend for OM surgery, which is a surgical procedure and should be less vulnerable to recall bias, while tonsillectomy rates were unchanged by age cohort. The latter indicate a slight increase in recurrent childhood OM over the last decades. A recent report on advances in OM inquires for longitudinal data over time [18].

4.2. Results

Surprisingly we found that during the time period 1925–1985, when the introduction of antibiotics completely changed the clinical picture of acute OM – and increased surgical efforts were put into the treatment of OME [8,9], the proportion of operations for OM remain stable, despite an increase both in reported OM history and surgery. Antibiotics, firstly used widespread during the second World [2], completely changed the clinical picture of ear disorders, with a reduction in mastoidectomy rates from 59% (119/202) to 3% (2/65) in the period 1937–1954 [3]. The virtual disappearance of the emergency cortical mastoidectomy led to an awareness and dominance of the lesser degrees of middle ear disease such as OME [2,19]. The second change during the study period was the reintroduction of ventilation tubes in 1954, leading to the increase in surgical treatment for OME [7,8,20]. The history of OME has been used as an example of how prevalence changes with diagnostic technology improvements such as otoscopy and impedance [8]. Further, it has been suggested that the amelioration of acute infections by antibiotics and possibly the formation of biofilms may explain that the disease appears to be more prevalent today due to the change in the bacterial environment from the use and overuse of antibiotics [8].

The increased rate of OM surgery in allergic patients, but stable rates of OM surgery, suggest a shift in clinical practice that favours surgery in those with allergy, and possibly also a change in surgery from acute infections to OME. As early as in 1954, it was observed that as much as one third of those with AOM and large adenoids were also allergic [3]. Since then it has been discussed that allergy

is a predisposing factor for OME [9]. Considerable scientific interest has been invested in the relationship between allergy and OM, but there has not yet been drawn a firm conclusion of the relationship [9–11]. As late as in 2010, the update on recent advances in OM concludes that the relationship between atopy and OM is incompletely understood and that there is a need for a clarification of diagnostic criteria for allergic disease as well as Ig-E mediated susceptibility [9].

In conclusion, despite a twofold increase in recurrent OM and OM surgery from 1925 to 1985, the proportion of operations remained stable, while surgery in allergic patients has become increasingly common. Our findings suggest a shift in clinical practice, most likely indicating a change in surgery from acute infections to OME.

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