

**RF-EMF
exposed cohort**

Feasibility of a cohort study of persons exposed to radiofrequency electromagnetic fields in an occupational setting

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- To evaluate the feasibility of a cohort study on health risks due to radiofrequency / microwave exposure in an occupational setting.
- Ideally the exposure should be similar in frequency range to the exposure to mobile phones, because these conditions would allow a transfer of results to the exposure to mobile phones.

- Radiofrequencies/microwaves
 - are defined as frequency range from 30,000 Hz up to 300 GHz.
 - Radiofrequencies < 300 MHz
 - Microwaves >300 MHz
- Cohort study
 - is defined as an observational study over a longer period (retrospective and/or prospective) on the basis of individual data.

Part 1 of the study

- Literature review
 - Cohort studies dealing with health effects from exposure to radiofrequencies/microwaves
 - Search performed in Medline, CancerLit, HealthStar, WHO EMF-database EMF-Portal (Aachen University)
 - Published between 1970 and 2002
 - English language
 - Overall 10 publications about 9 cohort studies were found

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Results (Literature Review)

Cohort	Exposed to:
US Navy technicians	microwaves
Canadian policy officers	microwaves
Polish military personnel	radio frequencies / microwaves
Workers on dielectric heat sealers (Italy)	radio frequencies
Amateur radio operators (US)	radio frequencies
Norwegian radio operators (merchant ships)	radio frequencies
Motorola employees (US)	radio frequencies
Workers in an electric pulse test program (US)	radio frequencies
Norwegian electrical workers	extremely low freq. / radio freq.

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Results (Literature Review)

Example: Brain tumors					
Exp.		Cases	Result	95 % CI	
RF	SMR	29	1.4	0.9 - 2.0	Amateur radio operators
RF/ELF	SIR	119	1.1	0.9 - 1.4	Electrical workers
RF	SIR	5	1.0	0.3 - 2.3	Radio operators (ships)
MW/RF	OER	85	1.9	1.1 - 3.5	Military personnel
MW	SIR	16	0.8	0.5 - 1.4	Police officers
RF	SMR	51	0.5	0.2 - 1.1	Motorola employees
MW	SMR	88	0.7	0.5 - 1.0	US Naval personnel

Part 2 of the study

- Selection of 23 (occupational) cohorts, considered as at least potentially exposed
 - Selection based on:
 - Literature review
 - Interviews with experts of professional associations and administrative bodies, and visits of firms

Cohorts initially defined as exposed (criteria catalogue)

- Conditions of exposure
 - Regular, over a longer time period
 - Higher than in general population
 - Exposure estimates on individual level
 - Retrospective estimate of exposure

- Possibility to set up a cohort and to follow-up
 - Well defined group of persons, demographic variables available (also retrospective)
 - Cohorts working in big firms are preferred (because of amount of work to collect data)

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Cohorts initially defined as exposed (examples)

Transmitters and Radar	Industry (cohort working with ...)	Others
<i>Captain in inland water transport (1)</i>	Deep drawing machine (1,2,3)	Assistant medical technician (2)
Airport workers (1)	Blister packaging (2,3)	Cashier (anti-theft-device) (2)
Telecommunication technicians (1,2)	Chip production (1)	
RF-research institute (2)	High frequency dryer (2)	
Fire brigade, emergency medical services, police (1,2)	<i>Gluing press (2)</i>	
1 = Condition of exposure not fulfilled	2 = Number of exposed subjects too small	3 = Automated and shielded processes

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Potential cohorts

Cohort of workers on
dielectric heat sealers

Cohort of engineers and technicians on
short and medium wave transmitters

Cohort of amateur radio operators

Potential cohorts

(workers on dielectric heat sealers)

Description

- Application area: Welding of plastic ware, tarpaulins, medical products
- Welding is a manual process when the number of pieces is small
- High frequency process: 27.12 MHz (industrial frequency)
- Exposure depends on the used welding electrode (shape of electrode), the duration of the welding process and the power of the generator
- Highly exposed person group
 - Exposure above authorized value (EF: 61.4V/m, MF: 0.18 A/m) is possible
- Long period of exposure (since the 1960s)
- Ca. 1,000 exposed persons (estimate)

Potential cohorts

(workers on dielectric heat sealers)

Advantages

- Highly exposed group (partly above authorized value)
- Small fluctuation of employees
- Willingness to cooperate (Trade Association of the Chemical Industry)
- Manufacturers of dielectric heat sealers can provide data about the emission of their devices

Potential cohorts (workers on dielectric heat sealers)

Disadvantages

- Only few exposed persons per firm
 - In most firms maximal 5 exposed employees
- Mix of exposures at workstation (low frequencies, plastic vapors)
- Different work sequences and for this reason a strong variance of exposure
- Only few personnel data available (no medical examination by company physicians carried out)
- It is difficult to find the firms (no register available)

Potential cohorts

(workers on dielectric heat sealers)

Conclusion

- Highly exposed cohort, but mix of exposures (low frequencies, plastic vapors)
- Small cohort
- No historical data available
- Establishment of cohort requires contacts to numerous small firms

Potential cohorts

(personnel on transmitting plans)

Description

- Personnel is exposed in operator rooms
- The duration of exposure corresponds to the daily working time
- Between 200 and 250 employees at 26 medium wave and 2 short wave transmitters
 - Employees only at transmitters with a transmitting power of more than 100 kW, all other transmitters are remote-controlled

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Potential cohorts (personnel on transmitting plans)

Transmitter Mühlacker

- Frequency: 576 kHz
- Transmitting power: ca. 100 kW

Exposure:

	Magnetic field intensity	Electric field strength
Control room	0.01 A/m	0.5 V/m
Mechanical shop	0.02 A/m	1.5 V/m
ICNIRP-threshold for general public		

Potential cohorts

(personnel on transmitting plans)

Advantages

- Current data on exposure available, also in the past
- Small fluctuation of the employees
- Internal control group is available (e.g. technicians working in switch rooms)
- Willingness to cooperate and to support a cohort study (e.g. by Südwestrundfunk - SWR)

Potential cohorts (personnel on transmitting plans)

Disadvantages

- Daily exposure is low, only during maintenance work at the mast possibly higher – exposure from reserve mast (4 times a year)
- Very small cohort
- Only technical vocations, highly selected group

Potential cohorts

(personnel on transmitting plans)

Conclusion

- Low exposure level
- Small cohort

Description

- Exposure duration will rarely exceed the value of 10h/week – with large individual variations
- High exposure arises as a result of adjustment of the antenna or other ‘work‘ on radio transmitters (according to DARC in some cases above authorized values)
- Less than 5 % of the amateur radio operators can transmit in the frequency range of mobile phones 900-2,200 MHz (most do not possess the technical equipment).

Advantages

- Most radio operators are exposed for a long time (20 years and more)
- Small fluctuation of cohort members
- Large cohort: 80,000 amateur radio operators, 60,000 organized in one association, active throughout Germany
- Demographic data available from DARC

Disadvantages

- No continuous exposure
- Retrospective quantification of exposure is not possible
- Very specific cohort
 - Most have technical vocations
(other exposures on the job?)

Conclusion

- Predominantly low exposure-levels
- A retrospective quantification of exposure is not possible

- No cohort group without substantial problems could be identified.
 - This applies also to the three potential cohorts.
 - The exposure levels in two of these cohorts are not significantly higher than in the general population and a mix of exposures exists (especially in workers on dielectric heat sealers).
 - Cohorts are small with the exception of amateur radio operators
- A cohort with an high exposure to radio frequency electromagnetic fields similar in frequency range to mobile phones was not found.
- Taking into account the disadvantages of the three potential cohorts, it was recommended to consider a cohort study of users of mobile phones as a fourth alternative.