1998:23

Comparison of symptoms experienced by users of analogue and digital mobile phones

A Swedish-Norwegian epidemiological study

Kjell Hansson Mild[1]
Gunnhild Oftedal[2]*
Monica Sandström[1]
Jonna Wilén[1]
Tore Tynes[3]
Bjarte Haugsdal[3]
Egil Hauger[4]

1. National Institute for Working Life, Umeå, Sweden
2. SINTEF Unimed, Trondheim, Norway
3. Norwegian Radiation Protection Authority, Oslo, Norway
4. Telenor Research and Development, Kjeller, Norway
**Current address: Norwegian University of Science and Technology Dept of Physics, Trondheim, Norway*

ARBETSLIVSRAPPORT
ISSN 1401-2928 http://www.niwl.se/arb/

Department of Technical Hygiene
Head: Ulf Landström

Arbetslivsinstitutet
National Institute for Working Life

Preface

This project was a collaborative effort between researchers from the National Institute for Working Life, Umeå, Sweden; SINTEF Unimed, Trondheim, Norway, and the Norwegian Radiation Protection Authority. An engineer from Telenor Research and Development participated as a consultant with respect to technical questions concerning mobile telephones.

This study was performed with the help of an international reference group who gave us guidance and advice throughout the course of the study. The group members were:

Prof Bengt Arnetz, Stockholm, Sweden
Dr George Carlo, Washington, USA
Dr Nancy Dreyer, Boston, USA
Prof Trevor Hughes, Oxford, UK
Dr Maila Hietanen, Helsinki, Finland
Ass prof Jonas Höög, Umeå, Sweden
Dr Gregory Lotz, Cincinatti, USA
Dr Mike Repacholi, Geneva, Schwitzerland
Dr Berndt Stenberg, Umeå, Sweden

We also used a Norwegian reference group comprising the following members:

Dr Svein Bjørneby, Oslo, Norway
Dr Fritz Bekkadal, Trondheim, Norway.

The work of the reference groups is greatly appreciated.

We would like to express our special thanks to Mr. Arvid Brandberg, CEO of the Swedish MTB, for all the help we received for the completion of this study. We thank Telia and Telenor for providing us with their subscription registers.

We gratefully acknowledge the help from Drs. Bengt Knave and Arne Wennberg with the medical interviews, which was part of the base of the questionnaire.

We received financial support from The Swedish Mobil Telecommunications Association (MTB); The Work Environment Fund of the Confederation of Norwegian Business and Industry; Telenor; The Norwegian Post and Telecommunication Authority. This is greatly appreciated.

This report is published by both the National Institute for Working Life, Umeå, Sweden and SINTEF Unimed, Trondheim, Norway (report no. STF78A98134).

Umeå and Trondheim, Aug. 1998.

Kjell Hansson Mild Gunnhild Oftedal

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In 1995 many people reported subjective disorders experienced while using mobile phones. Among the symptoms were headaches, feelings of discomfort, warmth behind/around or on the ear, and difficulties concentrating. The number of complaints from users of MPs was larger for GSM users, i.e. with pulse modulated fields. In the scientific literature there is a tendency for lower thresholds for biological effects from exposure to modulated fields. Our main hypothesis was that GSM users experience more symptoms than NMT users. A cross-sectional epidemiological investigation was initiated including 6379 GSM users and 5613 NMT users in Sweden, and 2500 from each category in Norway. The people were randomly selected from subscription registers where a company was the subscriber, but an individual was assigned to the phone. Questionnaires were used to register exposure factors, symptoms (both in general and symptoms related to the use of the mobile phone), and possible confounding factors such as gender, age, VDU-work and psychosocial factors for which the calculated odds ratios were adjusted. The estimated adjusted response rates were 64% for Norway and 76% for Sweden. The response rates were almost equal for the GSM subscribers and NMT subscribers. For no symptoms the prevalence was statistically significant higher for GSM users than for NMT users. Our hypothesis was therefore falsified. However, we observed a statistically significant lower risk for warmth sensations on, behind or around the ear for GSM users compared with NMT users. The same trend was seen in the Swedish data for headaches and fatigue. Factors distinguishing the two systems (radio frequency emission, the temperature of the phones, and various ergonomic factors) may be responsible for these results, as well as for the side finding: a statistically significant association between *calling time*/*number of calls* per day and the prevalence of warmth behind/around or on the ear, headaches and fatigue.

1. Introduction

1.1 Background

In Scandinavia one in every three people has a mobile phone (MP). In the 80's only the analogue system operating at either 450 or 900 MHz (NMT) was used, but today we also have the digital system (GSM) preferred by new subscribers. The GSM system was introduced in 1992 but the main increase in GSM users came in late 1994. During 1995 many people with symptoms experienced while using MPs, contacted manufacturers, net operators or researchers working with electromagnetic fields. The majority of the callers were using the new digital system; they had recently changed from an analogue to a digital phone or were new subscribers. The symptoms reported were, for example, headaches, feelings of discomfort, warmth behind/around or on the ear, and difficulties concentrating.

Present knowledge of health effects from low level microwave radiation is limited. All standard settings are based on thermal effects and the present guidelines for MPs are focused on limiting temperature increase in the head to 1^{o}C. Symptoms have previously been described in connection with exposure to low level radio frequency fields or microwaves. People exposed at work have complained of heavy feelings in the head, headaches, fatigue, poor memory etc. more often than controls (Marha et al., 1971; Baranski and Czerski, 1976; WHO, 1993). It was noted by Cohen and White (1972, quoted in WHO, 1993) that the onset of symptoms in predisposed individuals was usually precipitated or made worse by emotion-provoking circumstances or medical illness.

The symptoms described above for MP users are similar to neurasthenic symptoms and since the number of callers were not negligible it was considered of interest to start an epidemiological study to find out more about the prevalence of the symptoms and whether there was any connection to the use of MPs and if so to a particular transmitter system, i.e. NMT or GSM. It also came to our knowledge that similar symptoms had been reported from other countries (Robin Cox, UK, and Bruce Hocking, Australia, personal communication, 1995; Hocking, 1998).

1.2 GSM and NMT 900 systems.

The technical details of analogue and digital systems used for MPs have been described in detail (McKinlay et al., 1996; Bach Andersen et al., 1995) and only an outline is given here. The NMT systems operate at 450 or 900 MHz with a continuous carrier wave. The output from the hand-held NMT 450 phones is usually 1.5 W, and the maximum output power from the NMT 900 phones is 1 W, but earlier models had up to 6 W of output power. The NMT phones have their output power regulated through the base station in two levels, 0.1 or 1 W; the closer to the station, the lower the output power.

In the digital GSM system the information is sent in pulses with a repetition rate of 217 Hz. The pulse length and repetition frequency give a duty cycle of 1/8. The maximum output power is 2 W and this leads to a maximum mean value of 0.25 W. The GSM system also provides a battery saving function, and it can change the repetition frequency to 2 Hz when the user is just listening. If one listens as much as one talks this would in practice reduce the output power to half of the maximum. The output power is also regulated by the base station, from a maximum of 2 W down to a minimum of 20 mW. The mean output power is thus normally well below 0.1 W.

Different phones have a different design for the antenna position and physical dimensions, for instance, a dipole antenna or a helical antenna. The Specific Absorption Rate (SAR, unit W/kg) from several phones has been measured using a standardised procedure by Kuster and Balzano (1997), and Kuster (1997) recently performed an open test of different GSM phones and found that the SAR values vary from the lowest of 0.3 W/kg to the highest around 1.3 W/kg; all normalized to a standard output of 0.25 W.

Generally the GSM phones have a lower output power than the NMT 900 phones. The antenna systems used are similar for the two systems, and the SAR values, therefore, are slightly higher for the NMT 900 users. In the following presentation, NMT refers to NMT 900 when no further specification of the transmitter system is made.

The current from battery also gives rise to a magnetic field near the phone. For GSM phones magnetic flux densities of a few μT near the phone have been measured (Bach Andersen et al., 1995; Linde and Mild, 1995). The fields are pulsed DC fields, with a frequency of 217 Hz. For the NMT phones the magnetic field from the battery current is to be regarded as a pure DC field.

1.3 Aim of the study

In the scientific literature of biological effects of weak microwaves there is a tendency for lower thresholds of reported biological effects caused by exposure to modulated fields (Postow and Swicord, 1996). The number of complaints from users of MPs was larger for GSM users, i.e. with pulse modulated fields. This feature might have caused the problems. Our main hypothesis was therefore that GSM users experience more symptoms than NMT users. Two groups of users, one for each of the different systems, were identified, NMT 900 and GSM.

The media has focused on possible health effects caused by microwaves emitted by MPs. It is possible that fear or awareness might cause MP users to report more symptoms than people not using MPs even if the prevalence of symptoms was equal. We would not be able to estimate the impact of such a bias, and therefore a comparison between users and non-users of MPs would be difficult to interpret. Therefore, the study population was testified for MP users, and the *number of calls* per day and the *calling time* per day are used as estimates of exposure.

2 Materials and methods

2.1 Design of the study

The design was a cross-sectional, epidemiological study of GSM and NMT 900 users.

2.2 Selection criteria and procedure

Of the three net operators in Sweden only one supports both NMT and GSM transmission systems, so it was decided to use the register of this particular company. Similarly, we used the net operator in Norway that supports both NMT and GSM systems. We wanted to include people who continued the subscription and use of their MP even if they had experienced symptoms. Presumably, people using an MP in their job would be more likely to continue using it despite symptoms than would people with a private subscription. To include people with both low and intense use of MPs, we used the company register, i.e.

where a company was the subscriber, but an individual was assigned a phone; the questionnaire was mailed to such selected people. It was also a requirement that the phones were open to traffic, did not have a secret number, and were not closed to advertisements.

To get comparable groups of NMT and GSM users, it was a requirement that the subscriptions were entered some time after Jan 1, 1994, since GSM was introduced during 1992 and the main increase in subscriptions came in late 1994. The latest subscription entry accepted for the study was June 30, 1995 for Sweden and May 30, 1996 for Norway. To keep the names down to a reasonable number we randomly selected one last digit of the telephone number for the GSM users, and 3 digits for the NMTs. In Norway the two middle digits were used for the final selection of both NMT and GSM users. The numbers of people fulfilling these criteria by September 3, 1996 were about 8900 NMT users and 6500 GSM users in Sweden and 8300 and 3600 respectively in Norway. We then deleted those that did not include a full name (or those that the computer selected as a name but obviously were not) or address, those working abroad or those with a foreign name who might have had difficulty answering a detailed questionnaire in Swedish or Norwegian.

A pilot study involving 160 people selected from the registers tested the questionnaire during spring 1996. The final mailing was sent in October-November, 1996, and a reminder was sent out in November-December, 1996.

The final mailing lists consisted of 6379 GSM and 5613 NMT users in Sweden, and in Norway the corresponding figures were 2500 for each category.

2.3 Development of the questionnaire

We required a high response rate to the questionnaire, and since the people selected to participate were presumably rather busy people we chose to keep the number of questions down to a minimum. To be able to include the best description of subjective disorders we randomly selected 10 people from those who had called us individually and asked them to participate in a medical interview. These interviews were done in spring 1996 by Drs. Bengt Knave and Arne Wennberg, both at the NIWL, Stockholm. We also had contact with Drs. Robin Cox, UK, and Bruce Hocking, Australia, both of whom had been contacted by patients experiencing symptoms in connection with the use of MPs.

Based on these interviews and knowledge from the literature of low level RF effects reported by Marha et al. (1971) and Baranski and Czerski (1976), and our own experience from earlier questionnaire studies of similar phenomena among video display terminal (VDT) users (Stenberg et al., 1993; Oftedal et al., 1995, 1997), we formulated questions about symptoms.

In most studies concerning symptoms people are asked about their symptoms during the past 3 months, but in the present study this was extended to include ”symptoms during the past year”. This was done to include people who used a number of different MPs, and thereby identify the possibility that specific symptoms relate to a specific phone.

We included questions about confounding factors based on previous experiences (Tibblin et al., 1990; Stenberg et al., 1993; Bergdahl et al., 1994; Eriksson et al., 1997). Thus, we have included age, gender, geographical location of work place, amount of work with VDTs, occupation, and psychosocial factors.

The questionnaire was divided into two parts; the first to be filled in by all participants, the

second only by those who experienced symptoms connected to the use of an MP or an ordinary phone. This was done to find out more about the possible relationship with the use of MPs themselves and to see how the symptoms had affected the people in the form of visits to physicians, sick leave, and measures taken to reduce the problem. In addition, we wanted information about how swiftly symptoms developed, how long they lasted, and the conditions under which the symptoms typically occurred etc.

In the main, the results from the first part of the questionnaire are reported here.

Appendix G shows the questionnaires used in Swedish and Norwegian respectively, with an English translation. The translation has not been tested and validated, and certain details and culture differences might suffer in the English translation.

2.4 Optical reading

Each questionnaire was type-set for optical reading by Bothnia AB, Haparanda, Sweden, and the completed questionnaires were sent to them for optical reading. The questionnaires were read by computer, and the handwritten information and comments filled in by the participants were manually typed.

All data from the questionnaires were then entered onto CDs for further handling and analysis.

2.5 Definitions

The subjects were asked to state their present occupation. Based on this information and knowledge of what company they worked for we classified the occupations into different categories according to the Swedish AMY classification of occupation (AMSYK, 1997) which is based on the international standard ISCO-88.

We have used four different categories to classify the different occupations in the analysis.

Management: Leading position in companies or public administration and politicians.

Professional: Work that requires knowledge according to ISCO highest level, for instance, physicians, engineers and business administrators with at least 4 years of university education.

Intermediate: (non-manual employees) Occupation that demands shorter education at university, for instance, technicians, engineers, nurses.

Other: Work with no demand of university education including blue collar workers, secretaries, salesmen.

To estimate the psychosocial work load, an index was created. It was based on the four commonly used questions, by summing the ”score” of each of them, see Table 1. The following categories were then used in the analysis: low (0-2), medium (3-5), and high (6-12) psychosocial work load (see further Tables 4a and b). Note that a low value means that the person is experiencing a better psychosocial climate.

Table 1: Basis for creating the psychosocial index.

Question	Yes, often	Sometime	Seldom	Never
Do you consider your job to be interesting and stimulating?	0	1	2	3
Are you overloaded in your job?	3	1	1	3
Are you able to influence your working conditions, such as working at your own pace?	0	1	2	3
Do your colleagues assist you when you have problems with your job?	0	1	2	3

Many people in our study had more than one MP, see further Appendix B for details. The most commonly occurring combination was one NMT 900 and one GSM phone. To be able to use the information given by this group of users, we added the *calling time* for all MPs and the *number of calls* for all MPs. The questionnaire contained fixed categories for these variables and we assigned a fixed value (”mean value”) to each category according to the following:

< 2 mins/day = 1 min/day
2-15 mins/day = 8 mins/day
15-60 mins/day = 37 mins/day
>60 mins/day = 75 mins/day

and

< 2 calls/day = 1 call/day
2-4 calls/day = 3 calls/day
>4 calls/day = 5 calls/day.

These numbers were added and then the original categories were applied to the sum. Thus, a person with two MPs and a total *calling time* of < 2 mins/day would be assigned to the category 2-15 mins/day.

The distribution of the number of users within each category for this group is given in Table 4.

Appendix A shows the definitions and abbreviations used in the text.

2.6 Non-respondent analysis

The non-respondent analysis investigated why subjects did not respond to the questionnaire, and compared symptoms between non-respondents and respondents. Because of the relatively low response rate in Norway, we also investigated potential risk factors for non-respondents compared to respondents. See Appendix D for more details.

2.7 Statistical analysis

Odds ratios (OR) were used as a measure of the different risk factors and the outcome variables. The OR is an estimation of the relative risk of having a symptom.

Univariate logistic regression was used to judge which factors might have an effect on and confound the statistical relationship between exposure factors (transmitter system, *calling time* etc.) and symptom occurrence. Multivariate logistic regression was performed in two steps. First, possible confounding factors, as well as the exposure factors (that were

suggested by the univariate analysis to influence the prevalence of symptoms) were included in multivariate logistic regressions with forward selection (Wald statistics). Secondly, if the significance probability of a factor based on score statistics was 5% or less, this factor was included in the final logistic regression model for the actual exposure factor. Similarly, 95% confidence intervals were used to judge whether the estimated ORs were statistically significant. The SPSS package was used throughout.

3 Results

3.1 Response rate

The response rate to the questionnaire was 58% for Norway and 65% for Sweden. These figures were calculated by correcting for the number of questionnaires that were returned because of unknown address of the selected person. (See Table 2.)

Table 2: Number of questionnaires distributed, returned because of unknown address of selected person, answered, and response rate.

Transmitter system	Norway				Sweden			
	Distributed	Returned, not answered	Answered	Response rate[1)]	Distributed	Returned, not answered	Answered	Response rate[1)]
NMT 900	2500	66	1420	58%	6379	82	4199	66%
GSM	2500	82	1408	58%	5611	72	3604	64%
Total	5000	148	2828	58%	11990	154	7803	65%

1.Calculated as: No. of answered questionnaires /(No. of distributed questionnaires– No. of returned questionnaires).

The non-respondent analysis indicated that of those who did not respond 21% in Norway and 43% in Sweden had not received the questionnaire. (For more details on the non-respondent analysis see section 3.6.) If the estimated total number of those who did not receive the questionnaire is subtracted from the number that was selected for the study, the estimated ”adjusted” response rate was 64% for Norway and 76% for Sweden.

As indicated in Table 2, the response rates were almost equal for the GSM subscribers and NMT subscribers. (In this Table the GSM and NMT subscribers are defined by the transmitter system given in the list of subscribers used for selection of subjects for the study. Some subjects, however, indicated in the questionnaire a transmitter system different from the one defined, or indicated two or more MPs with different transmitter systems.)

3.2 Distribution of respondents due to individual and exposure factors

The distribution of respondents between various categories of transmitter systems is presented in Table 3. Three categories are defined: ”GSM”- people with one MP, ”NMT 900” - people with one NMT 900 MP, and ”Mixed” - people with NMT 450, any combination of transmitter systems, GSM or NMT 900 with more than one MP, and people for whom information about transmitter systems was missing. In both Norway and Sweden the number of respondents using GSM was somewhat higher than the number using NMT 900.

Table 3: Number of respondents with different categories of transmitter system. See text for explanation of the categories.

	Norway				Sweden			
	Transmitter system			Total	Transmitter system			Total
	NMT 900	GSM	Mixed		NMT 900	GSM	Mixed	
Count	873	1001	954	2828	1915	2634	3254	7803
Percent	31%	35%	34%	100%	24%	34%	42%	100%

The distribution of respondents between all transmitter systems and all combinations of them is presented in Appendix B.

The distribution of people in different categories of possible confounding factors (individual and work related factors) as well as exposure factors (factors related to the MP and the use of it), is given in Tables 4a and b. The results are given for each category of transmitter system as well as for the total group of respondents.

For most of the individual factors there are some differences between the two countries. In Sweden there are slightly more women and fewer young people among the respondents than in Norway. There are also some differences in occupation. In particular, the number of people with an occupation classified as ”management” is higher in the Norwegian data than in the Swedish.

Some differences are also revealed for exposure factors. The Swedish respondents have used their MPs for a longer period of time than the Norwegians, while the Norwegian respondents have used their MPs more frequently and also had longer *calling times* per day than the Swedish.

When comparing the transmitter systems, we see that people with NMT have used their MPs for a longer period of time than people with GSM. In particular for Norway, the *number of calls* per day is higher for NMT users than for GSM users. For the Norwegian material only, there is a slight difference in the *calling time* per day: NMT users tended to have the longest *calling times*.

In the questionnaire inconsistent replies were given to the questions concerning the use of hands-free equipment or external vehicle mounted antennas, suggesting a significant misclassification of the factor ”hands-free/external antenna”. This factor is therefore not included in the further analysis.

The respondents also evaluated their state of health. The relative number of respondents who indicated that their state of health was good was higher among the Norwegian respondents (83%) than among the Swedish respondents (71%). There were only small differences in the state of health between GSM users and NMT users. More details are given in Appendix B.

*Table 4a: Distribution of respondents for the categories of transmitter system and for the total group of respondents in **Norway**.*

Factor	Category	Transmitter system						Total	
		NMT 900		GSM		Mixed			
		Count	Percent	Count	Percent	Count	Percent	Count	Percent
Gender	Male	781	90	905	90	867	91	2553	90
	Female	92	10	96	10	87	9.1	275	9.7
	Missing	0	0.0	0	0.0	0	0.0	0	0.0
Age	< 30 years	101	12	99	9.9	108	11	308	11
	30 - 39 years	314	36	400	40	346	36	1060	37
	40 - 49 years	268	31	299	30	310	33	877	31
	≥ 50 years	178	20	184	18	167	18	529	19
	Missing	12	1.4	19	1.9	23	2.4	54	1.9
Geography	Largest city	421	48	605	60	527	55	1553	55
	Other places	452	52	396	40	427	45	1275	45
	Missing	0	0.0	0	0.0	0	0.0	0	0.0
Occupation	Management	278	32	349	35	381	40	1008	36
	Professional	174	20	253	25	176	18	603	21
	Intermediate	253	29	208	21	221	23	682	24
	Other	94	11	90	9.0	89	9.3	273	9.7
	Missing	74	8.5	101	10	87	9.1	262	9.3
Psychosocial work load	Low	328	38	343	34	331	35	1002	35
	Medium	389	45	455	46	429	45	1273	45
	High	139	16	193	19	179	19	511	18
	Missing	17	1.9	10	1.0	15	1.6	42	1.5
VDT work	No VDT-work	209	24	131	13	158	17	498	18
	< 1 hr/day	192	22	144	14	181	19	517	18
	1 - 4 hrs/day	352	40	483	48	459	48	1294	46
	> 4 hrs/day	95	11	222	22	129	14	446	16
	Missing	25	2.9	21	2.1	27	2.8	73	2.6
Handsfree/ external antenna	Always	242	28	196	20	153	16	591	21
	Sometimes	113	13	105	10	412	43	630	22
	Never	507	58	694	69	373	39	1574	56
	Missing	11	1.3	6	0.6	16	1.7	33	1.2
Time with MP[1]	< 13 months	314	36	500	50	384	40	1199	42
	13 - 24 months	283	32	274	27	214	22	772	27
	> 24 months	230	26	146	15	316	33	695	25
	Missing	46	5.3	81	8.1	40	4.2	162	5.7
Number of calls/day[2]	< 2 calls/day	100	12	148	15	17	1.8	265	9.4
	2 - 4 calls/day	236	27	343	34	163	17	742	26
	> 4 calls/day	534	61	508	51	767	80	1810	64
	Missing	3	0.3	2	0.2	7	0.7	11	0.4
Calling time per day[3]	< 2 mins/day	61	7.0	76	7.6	11	1.2	148	5.2
	2 - 15 mins/day	412	47	528	53	161	17	1101	39
	15 - 60 mins/day	332	38	352	35	450	47	1134	40
	> 60 mins/day	65	7.4	45	4.5	323	34	433	15
	Missing	3	0.3	0	0.0	9	0.9	12	0.4

For people with more than one MP:

1. Time with MP is defined as the time with the longest used MP.
2. Number of calls per day is defined as the sum of number of calls for all MPs.
3: Calling time per day is defined as the sum of the calling time for all MPs.

*Table 4b: Distribution of respondents for the categories of transmitter system and for the total group of respondents in **Sweden**.*

Factor	Category	Transmitter system						Total	
		NMT 900		GSM		Mixed			
		Count	Percent	Count	Percent	Count	Percent	Count	Percent
Gender	Male	1631	85	2207	84	2881	89	6719	86
	Female	284	15	427	16	371	11	1082	14
	Missing	0	0.0	0	0.0	2	0.1	2	0.0
Age	< 30 years	106	5.5	155	5.9	227	7.0	488	6.3
	30 - 39 years	427	22	655	25	722	22	1804	23
	40 - 49 years	667	35	903	34	1122	34	2692	34
	≥ 50 years	704	37	902	34	1159	36	2765	35
	Missing	11	0.6	19	0.7	24	0.7	54	0.7
Geography	Largest city	217	11	603	23	444	14	1264	16
	Southern Sweden	924	48	1719	65	1832	56	4475	57
	Northern Sweden	770	40	306	12	966	30	2042	26
	Missing	4	0.2	6	0.2	12	0.4	22	0.3
Occupation	Management	398	21	775	29	832	26	2005	26
	Professional	331	17	602	23	503	15	1436	18
	Intermediate	687	36	707	27	1105	34	2499	32
	Other	323	17	277	11	521	16	1121	14
	Missing	176	9.2	273	10	293	9.0	742	9.5
Psychosocial work load	Low	769	40	947	36	1232	38	2948	38
	Medium	808	42	1218	46	1401	43	3427	44
	High	290	15	394	15	508	16	1192	15
	Missing	48	2.5	75	2.8	113	3.5	236	3.0
VDT work	No VDT work	445	23	346	13	691	21	1482	19
	< 1 hr/day	436	23	518	20	750	23	1704	22
	1 - 4 hrs/day	793	41	1201	46	1337	41	3331	43
	> 4 hrs/day	209	11	524	20	420	13	1153	15
	Missing	32	1.7	45	1.7	56	1.7	133	1.7
Handsfree/ external antenna	Always	532	28	598	23	535	16	1665	21
	Sometimes	177	9.2	259	10	1557	48	1993	26
	Never	1147	60	1690	64	1066	33	3903	50
	Missing	59	3.1	87	3.3	96	3.0	242	3.1
Time with MP[1]	< 13 months	338	18	670	25	851	26	1859	24
	13 - 24 months	748	39	1257	48	629	19	2634	34
	> 24 months	750	39	613	23	1639	50	3002	38
	Missing	79	4.1	94	3.6	135	4.1	308	3.9
Number of calls/day[2]	< 2 calls/day	425	22	620	24	142	4.4	1187	15
	2 - 4 calls/day	634	33	932	35	782	24	2348	30
	> 4 calls/day	851	44	1071	41	2286	70	4208	54
	Missing	5	0.3	11	0.4	44	1.4	60	0.8
Calling time per day[3]	< 2 mins/day	304	16	408	16	101	3.1	813	10
	2 - 15 mins/day	1076	56	1457	55	971	30	3504	45
	15 - 60 mins/day	476	25	683	26	1518	47	2677	34
	> 60 mins/day	52	2.7	77	2.9	617	19	746	10
	Missing	7	0.4	9	0.3	47	1.4	63	0.8

For people with more than one MP:

1. Time with MP is defined as the time with the longest used MP.
2. *Number of calls* per day is defined as the sum of *number of calls* for all MPs.
3: *Calling time* per day is defined as the sum of the *calling time* for all MPs.

3.3 Symptoms versus individual and work related factors

An individual was defined as having a symptom if he/she had indicated that the symptom occurred at least once a week. In this chapter, the prevalence of symptoms due to individual factors, work-related and exposure factors are presented in histograms (Figures 1-10). For individual and work related factors as well as for *time with MP* crude ORs are given in Tables 5-8.

As can be seen in the Figures, the trend in the data was about the same in the two countries. However, in general there was a higher prevalence of symptoms among the Norwegian respondents as compared to the Swedish respondents. Furthermore, when comparing the different symptoms within the countries, fatigue seemed to be a more dominating symptom in Sweden while a feeling of warmth on/behind the ear was more dominating in Norway. In Norway 3% and in Sweden 5% reported ”other symptoms”, and among these eye, ear and neck problems were most often specified. In Sweden, facial skin problems were also quite commonly specified.

The results suggest that both individual factors, as well as all work related factors, might influence the prevalence of some symptoms. For instance, factors such as age, psychosocial work load, and amount of VDT work are important for the prevalence of most of the symptoms. In Table 8 the relationship between psychosocial work load (given as the index) and prevalence of symptoms is given. Those with a high score had more symptoms than those with a low score. Among the Swedish users we found statistical significance for all listed symptoms - both for the groups with index *medium* and *high* - and for the Norwegian users most symptoms reached statistical significance.

The exposure factors *calling time* and *number of calls* per day are of importance for the prevalence of symptoms as can be seen in Figures 9 and 10. These factors are further analysed and the results are presented in section 3.5 below.

The crude ORs (Table 9) do not indicate a correlation between the prevalence of symptoms and the *period of time* for which the respondents used their MPs. To see whether a potential correlation might have been masked by a possible confounding effect caused by other risk factors, *period of time* was included in multivariate logistic regression with forward selection. No analysis revealed any usage time effect of MPs. This factor is therefore not used in further multivariate analysis.

We analysed whether people who reported a sensation of warmth on/behind the ear experienced other symptoms more often than people without such warmth sensations. The risk of having a symptom from the nervous symptom was 2 to 4 times higher among those who had reported a sensation of warmth on/behind the ear compared to those who did not report any of these symptoms. One exception was the symptom of tingling/tightness in facial skin for which the risk was 5 to 8 higher for those who had reported a sensation of warmth than for those who had not. People reporting one of the two warmth sensation symptoms had a 10 to 20 times higher risk of also having the other warmth sensation symptom and in addition the sensation of burning skin.

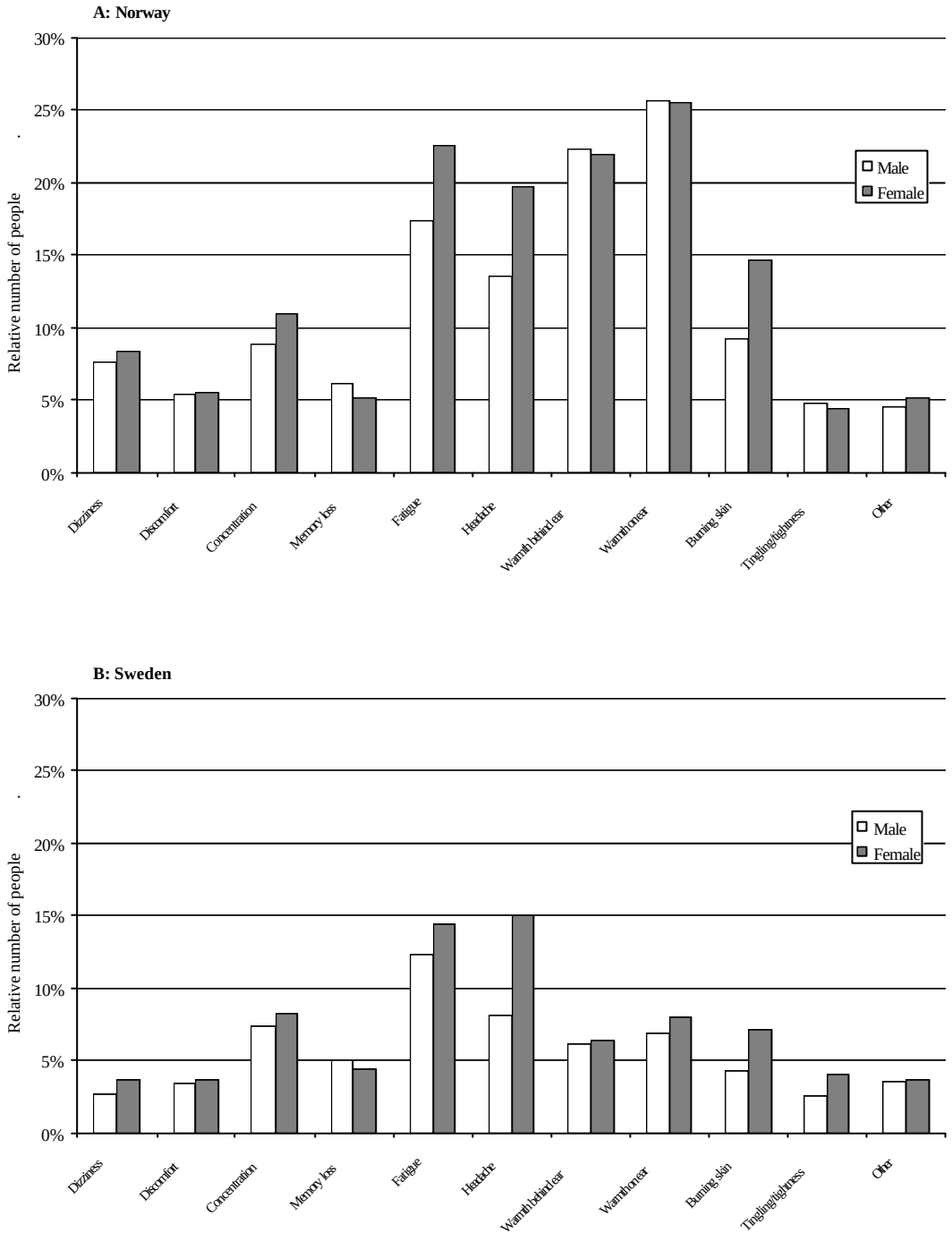

Figure 1. Prevalence of symptoms among males and females respectively. A: Norway. B: Sweden

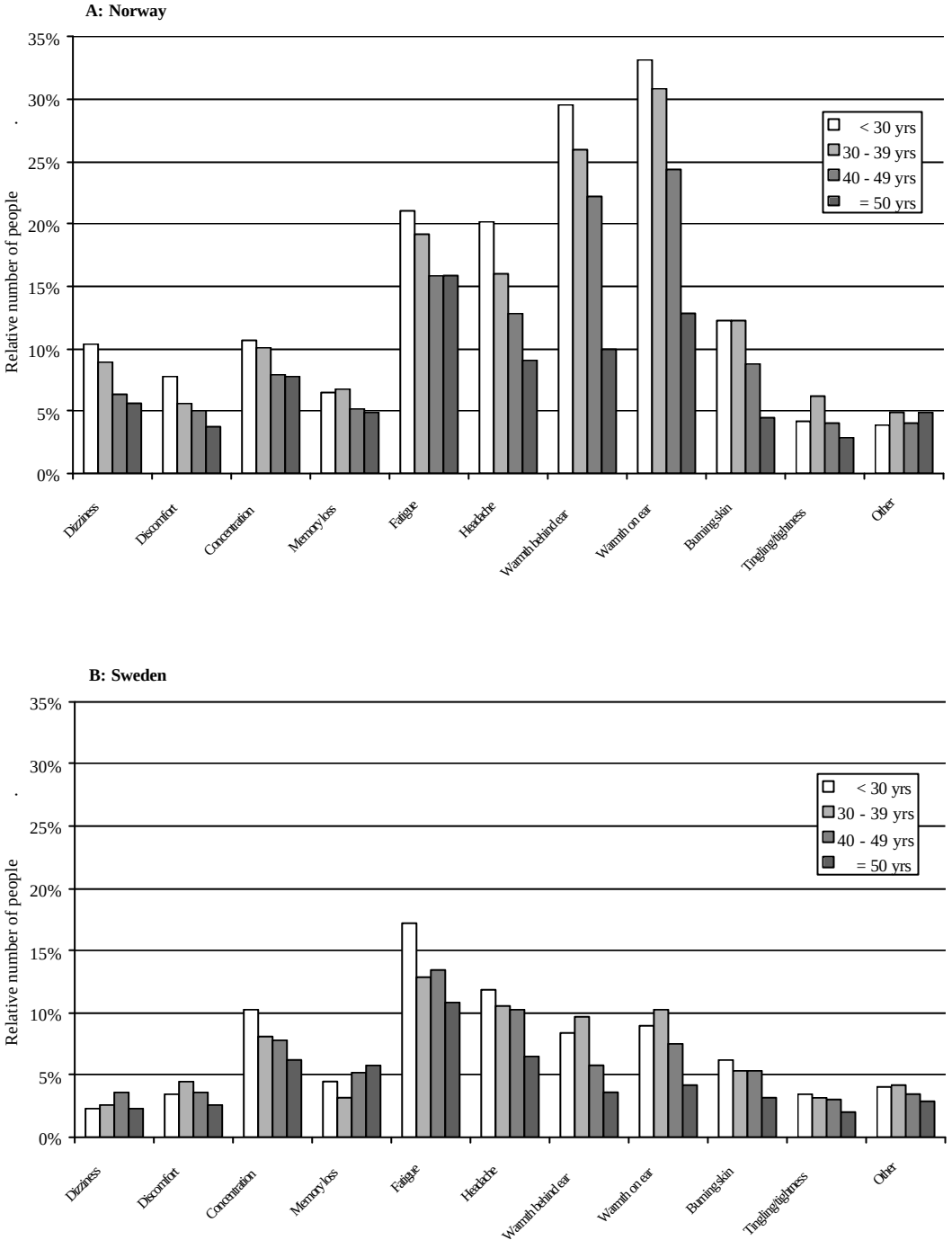

Figure 2. Prevalence of symptoms within various age categories. A: Norway, B: Sweden

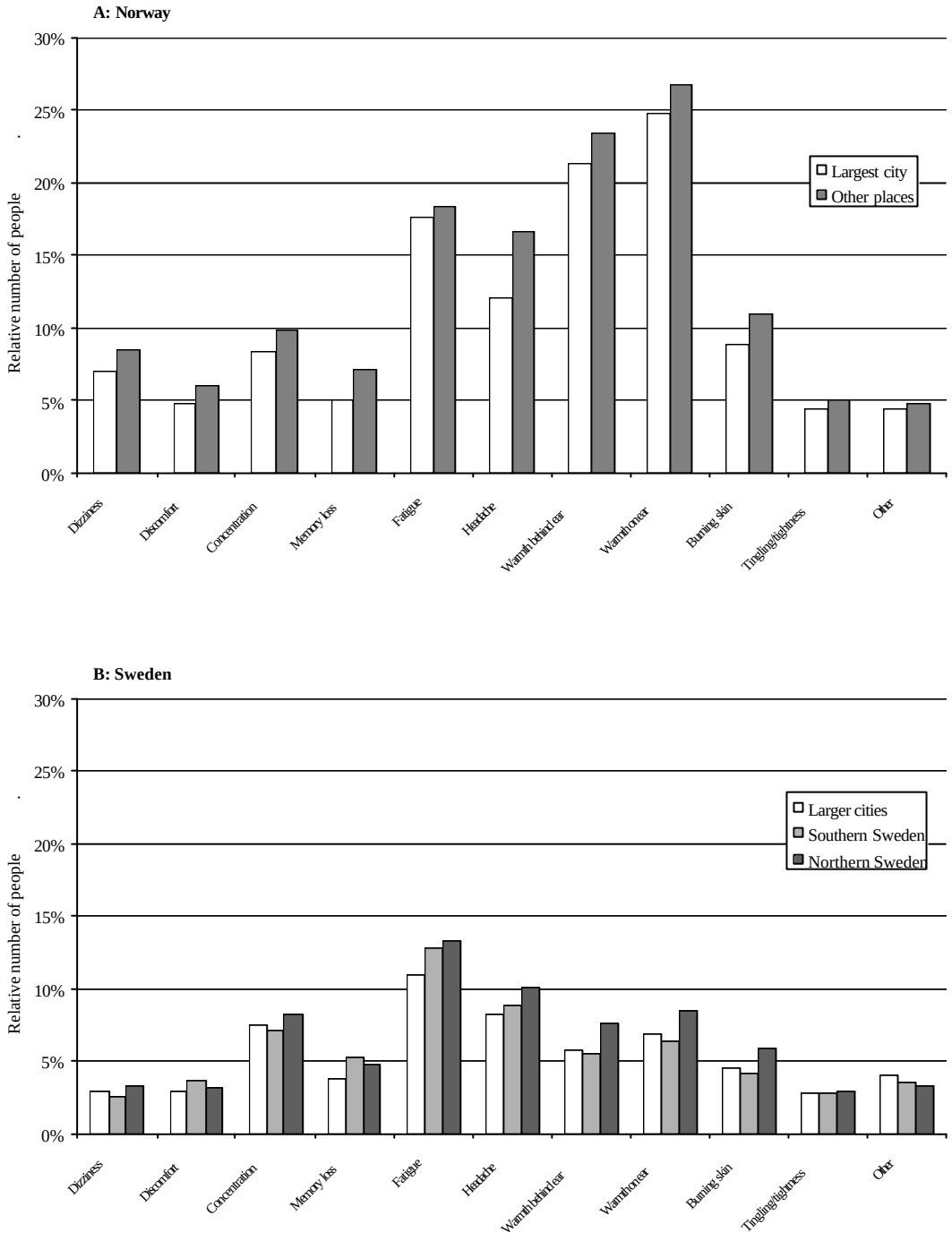

Figure 3. Prevalence of symptoms within various geographical categories. A: Norway, B: Sweden

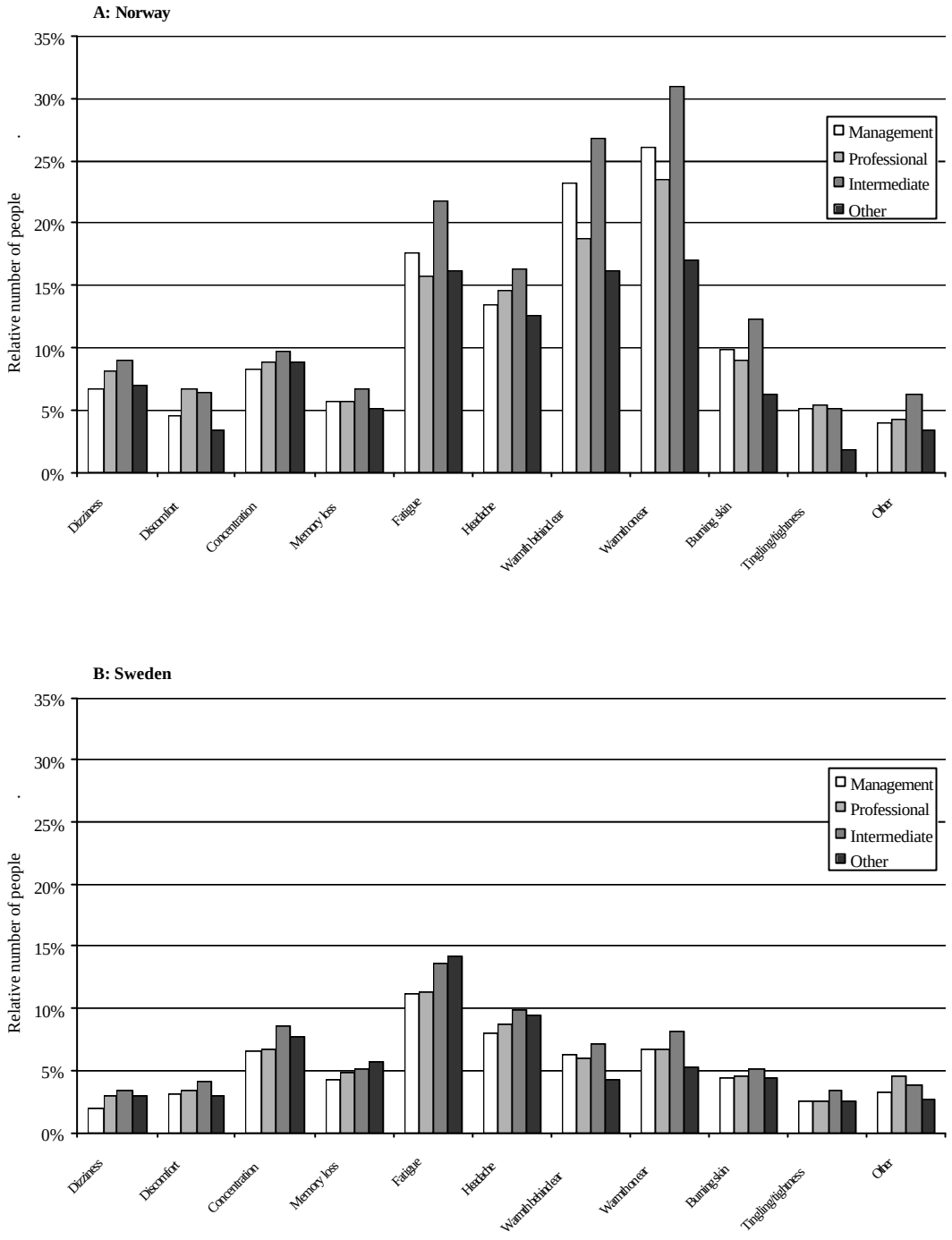

Figure 4. Prevalence of symptoms within various occupation categories. A: Norway, B: Sweden

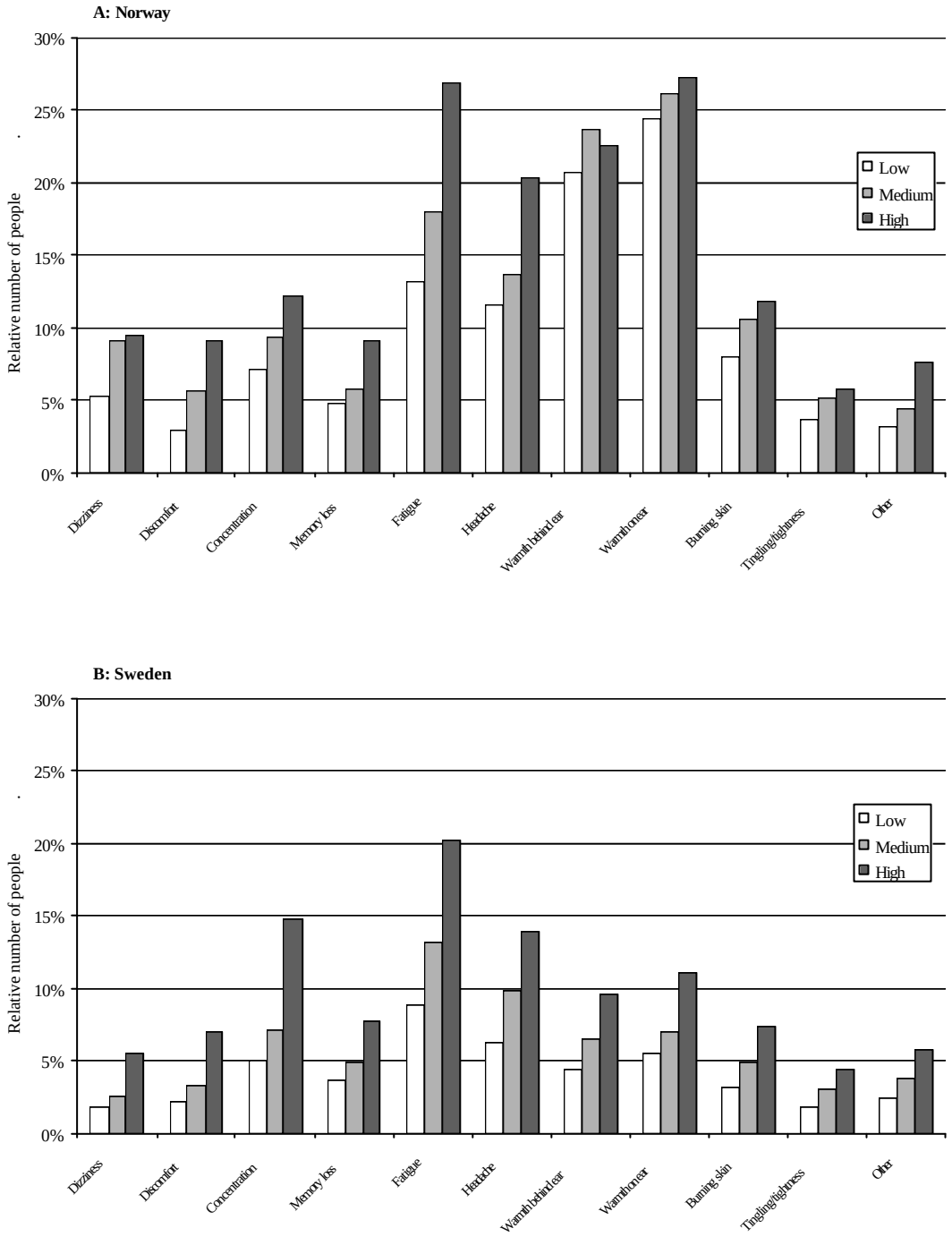

Figure 5. Prevalence of symptoms within categories with various psychosocial work load.
A: Norway, B: Sweden

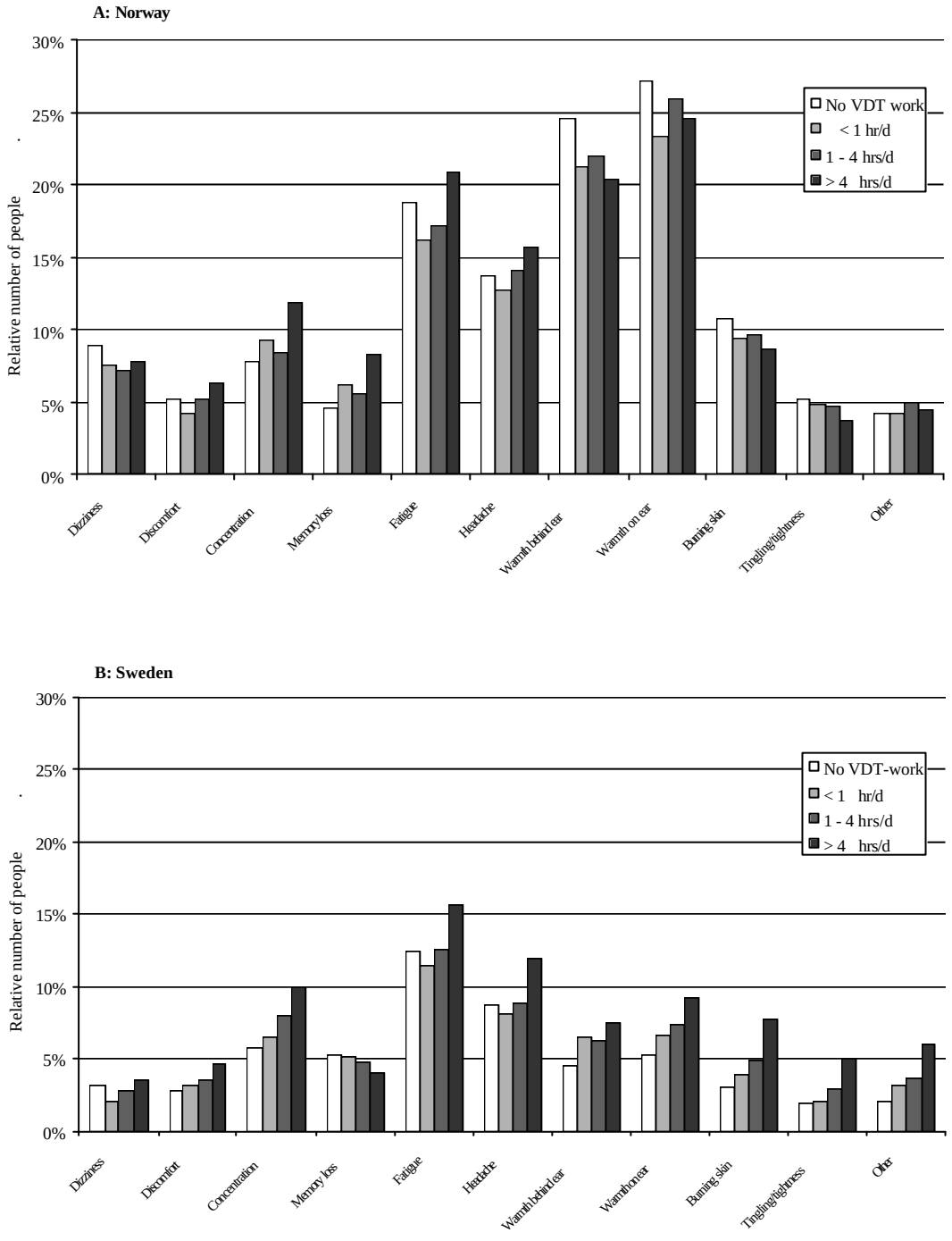

Figure 6. Prevalence of symptoms within various categories of VDT-work. A: Norway, B: Sweden

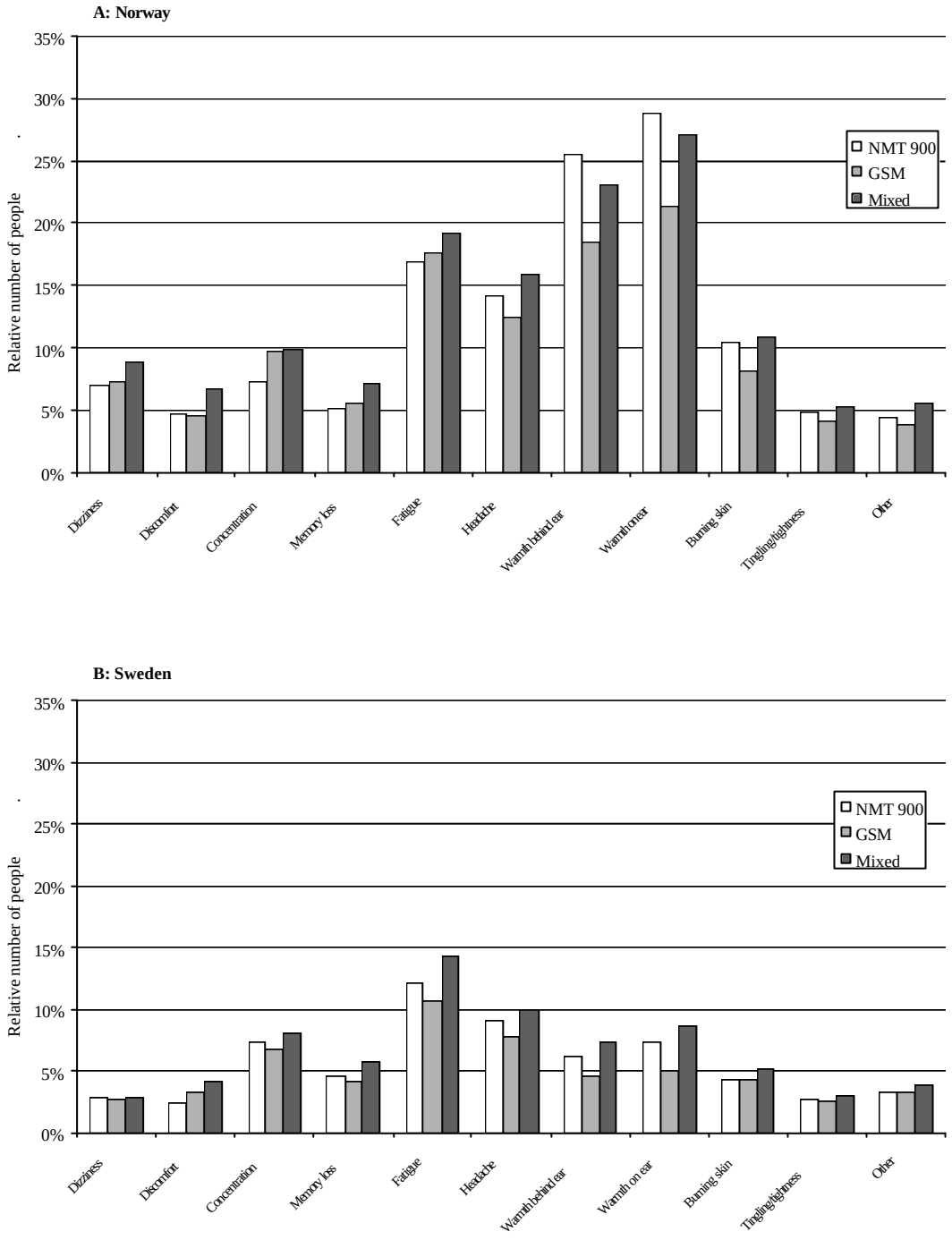

Figure 7. Prevalence of symptoms within various transmitter systems. A: Norway, B: Sweden

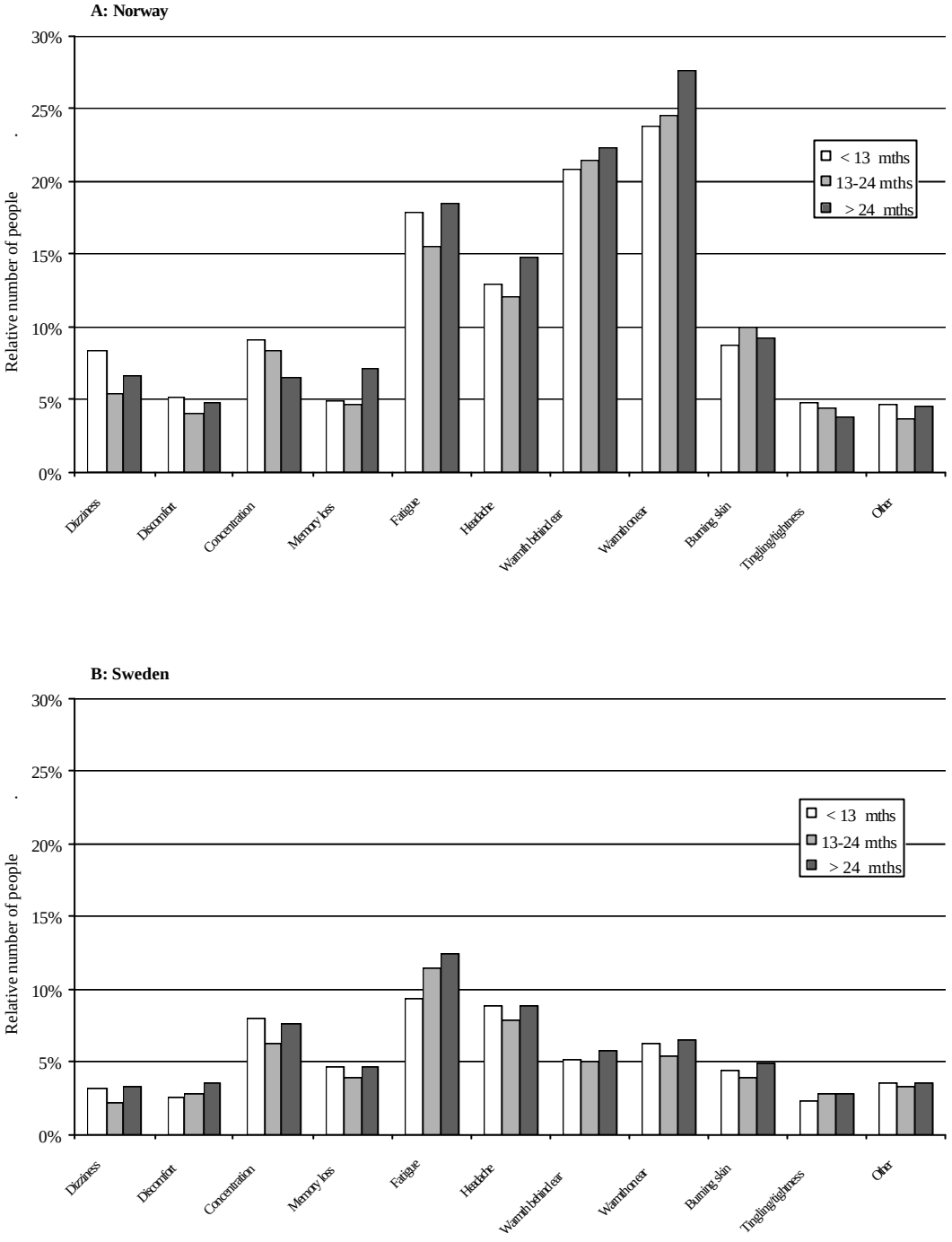

Figure 8. Prevalence of symptoms within time categories of possessing an MP. A: Norway, B: Sweden

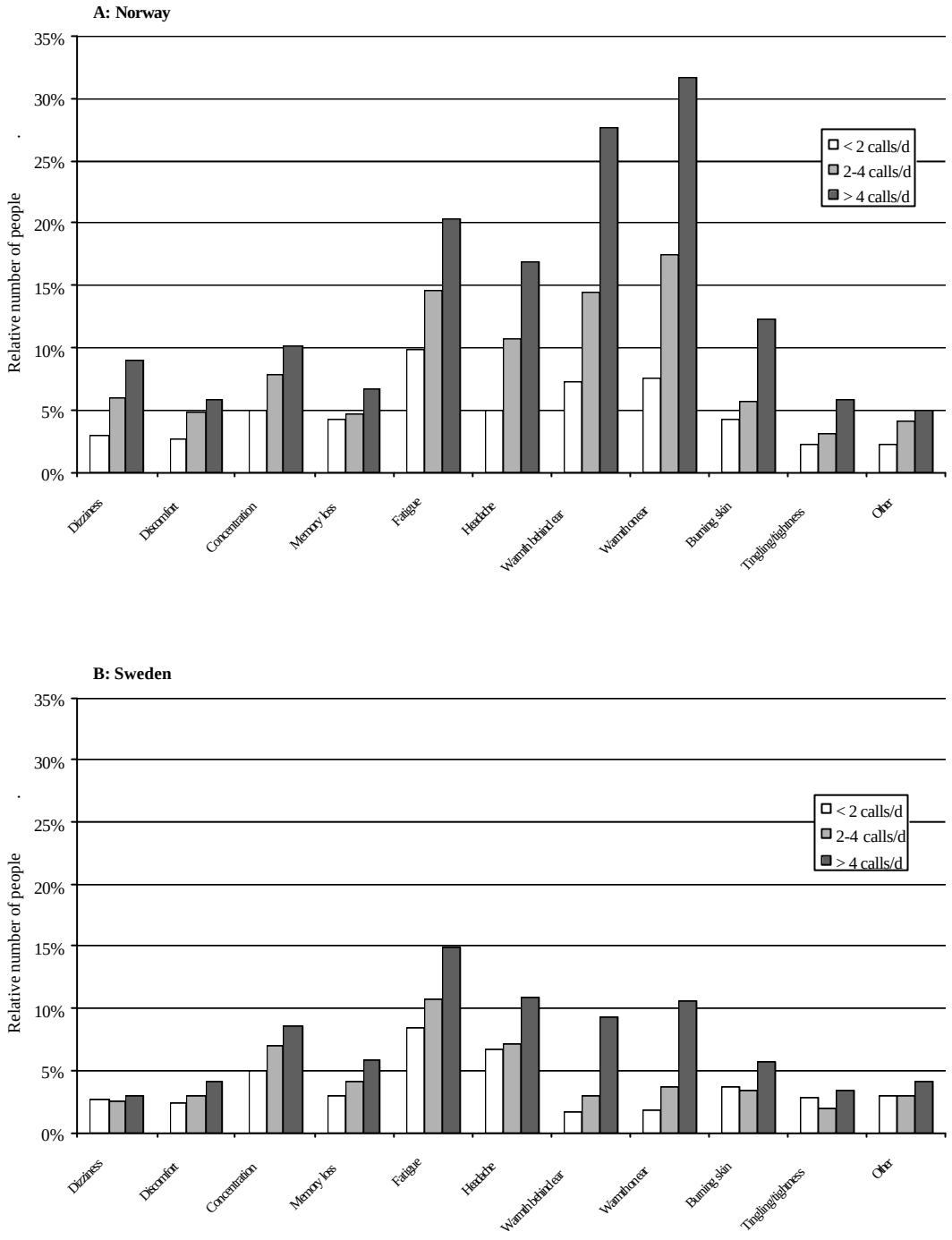

Figure 9. Prevalence of symptoms within various categories of number of calls/day. A: Norway, B: Sweden

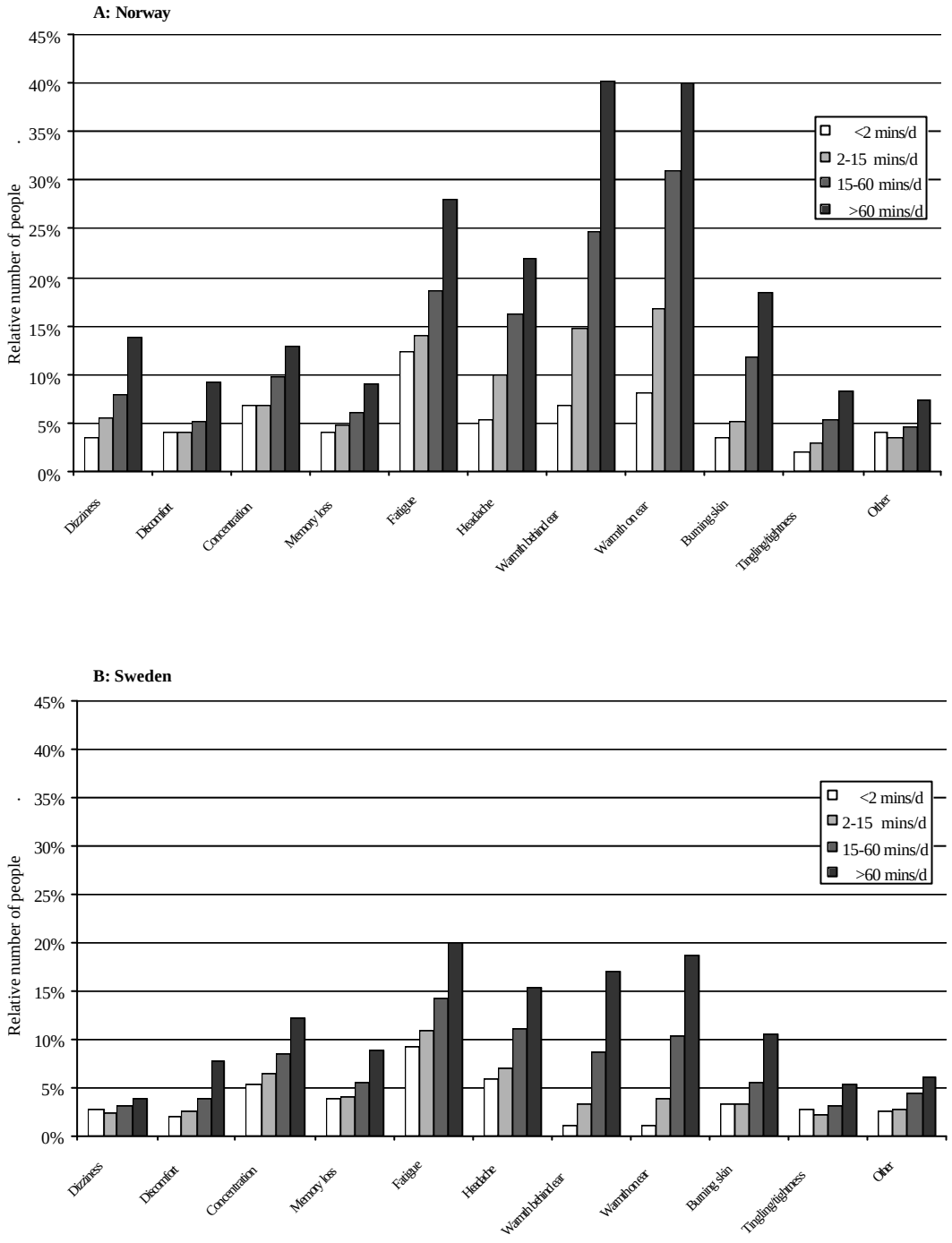

Figure 10. Prevalence of symptoms within various categories of length of calling time/day.
A: Norway, B: Sweden

Table 5. Crude ORs and in brackets 95% confidence intervals for different symptoms with respect to individual factors. The reference category for gender is "male" and for age "³ 50 years" .

A: Norway

	OR (95% C.I.)			
	Gender	Age		
Symptoms	Female	< 30 years	30-39 years	40-49 years
Dizziness	1.11 (0.71-1.74)	**1.93 (1.15-3.24)**	**1.63 (1.06-2.49)**	1.14 (0.72-1.79)
Discomfort	1.03 (0.60-1.79)	**2.15 (1.17-3.96)**	1.51 (0.90-2.53)	1.35 (0.78-2.31)
Concentration	1.27 (0.85-1.90)	1.43 (0.88-2.31)	1.33 (0.91-1.94)	1.02 (0.68-1.52)
Memory loss	0.84 (0.48-1.47)	1.34 (0.74-2.45)	1.40 (0.88-2.22)	1.05 (0.64-1.72)
Fatigue	**1.38 (1.02-1.87)**	1.42 (0.99-2.03)	1.26 (0.95-1.67)	1.00 (0.74-1.34)
Headaches	**1.57 (1.14-2.16)**	**2.53 (1.68-3.79)**	**1.91 (1.36-2.68)**	**1.47 (1.03-2.10)**
Warmth behind ear	0.98 (0.72-1.32)	**3.77 (2.59-5.48)**	**3.15 (2.30-4.32)**	**2.57 (1.86-3.56)**
Warmth on ear	0.99 (0.75-1.32)	**3.35 (2.37-4.75)**	**3.01 (2.26-4.01)**	**2.19 (1.63-2.95)**
Burning skin	**1.67 (1.17-2.40)**	**2.95 (1.74-5.03)**	**2.95 (1.88-4.62)**	**2.02 (1.26-3.24)**
Tingling/tightness	0.92 (0.50-1.68)	1.51 (0.71-3.22)	**2.29 (1.29-4.05)**	1.47 (0.80-2.71)
Other	1.14 (0.64-2.01)	0.78 (0.39-1.58)	1.00 (0.62-1.63)	0.83 (0.49-1.39)

In bold $p<0.05$

B: Sweden

	OR (95% C.I.)			
	Gender	Age		
Symptoms	Female	< 30 years	30-39 years	40-49 years
Dizziness	**1.42 (1.00-2.02)**	0.99 (0.52-1.89)	1.12 (0.76-1.65)	**1.59 (1.15-2.19)**
Discomfort	1.10 (0.78-1.54)	1.37 (0.80-2.34)	**1.78 (1.29-2.46)**	**1.42 (1.04-1.94)**
Concentration	1.13 (0.90-1.44)	**1.71 (1.23-2.38)**	**1.33 (1.06-1.67)**	**1.26 (1.02-1.55)**
Memory loss	0.90 (0.66-1.22)	0.77 (0.49-1.22)	0.54 (0.4-0.74)	0.89 (0.71-1.13)
Fatigue	1.20 (0.99-1.44)	**1.72 (1.32-2.24)**	**1.23 (1.02-1.47)**	**1.29 (1.09-1.52)**
Headaches	**2.01 (1.67-2.43)**	**1.96 (1.43-2.68)**	**1.72 (1.39-2.13)**	**1.65 (1.36-2.01)**
Warmth behind ear	1.06 (0.81-1.37)	**2.39 (1.64-3.49)**	**2.82 (2.19-3.63)**	**1.61 (1.25-2.08)**
Warmth on ear	1.17 (0.92-1.49)	**2.24 (1.56-3.22)**	**2.58 (2.03-3.28)**	**1.83 (1.45-2.31)**
Burning skin	**1.73 (1.33-2.24)**	**1.95 (1.27-2.98)**	**1.67 (1.24-2.24)**	**1.67 (1.27-2.18)**
Tingling/tightness	**1.59 (1.13-2.22)**	1.68 (0.97-2.91)	**1.52 (1.05-2.20)**	**1.47 (1.04-2.06)**

	OR (95% C.I.)			
	Gender	Age		
Symptoms	Female	< 30 years	30-39 years	40-49 years
Other	1.02 (0.72-1.44)	1.40 (0.85-2.30)	**1.46 (1.06-2.00)**	1.20 (0.89-1.62)

In bold p<0.05

Table 6. Crude ORs and in brackets 95% confidence intervals for different symptoms with respect to occupation. The reference category is "management".

A: Norway

	OR (95% C.I.)		
Symptoms	Professional	Intermediate	Other
Dizziness	1.24 (0.85-1.82)	1.38 (0.96-1.98)	1.06 (0.62-1.79)
Discomfort	1.49 (0.96-2.30)	1.44 (0.94-2.20)	0.72 (0.35-1.48)
Concentration	1.07 (0.75-1.54)	1.19 (0.85-1.67)	1.08 (0.67-1.74)
Memory loss	1.00 (0.64-1.54)	1.18 (0.79-1.76)	0.91 (0.50-1.65)
Fatigue	0.87 (0.66-1.14)	**1.29 (1.01-1.64)**	0.90 (0.63-1.29)
Headaches	1.10 (0.83-1.48)	1.25 (0.96-1.65)	0.93 (0.62-1.38)
Warmth behind ear	0.77 (0.60-0.99)	1.22 (0.97-1.52)	**0.64 (0.45-0.92)**
Warmth on ear	0.86 (0.68-1.09)	**1.27 (1.02-1.57)**	**0.58 (0.41-0.82)**
Burning skin	0.89 (0.63-1.26)	1.27 (0.94-1.73)	0.61 (0.36-1.03)
Tingling/tightness	1.03 (0.66-1.62)	0.99 (0.64-1.54)	0.35 (0.14-0.87)
Other	1.09 (0.66-1.81)	**1.63 (1.04-2.53)**	0.83 (0.40-1.73)

In bold p<0.05

B: Sweden

	OR (95% C.I.)		
Symptoms	Professional	Intermediate	Other
Dizziness	1.52 (0.98-2.34)	**1.71 (1.17-2.50)**	1.49 (0.93-2.37)
Discomfort	1.08 (0.74-1.59)	1.32 (0.96-1.82)	0.95 (0.62-1.46)
Concentration	1.01 (0.77-1.32)	**1.33 (1.06-1.66)**	1.19 (0.90-1.58)
Memory loss	1.14 (0.82-1.58)	1.24 (0.94-1.64)	1.37 (0.98-1.91)
Fatigue	1.01 (0.81-1.25)	**1.25 (1.04-1.49)**	**1.30 (1.05-1.62)**
Headaches	1.11 (0.87-1.41)	**1.27 (1.03-1.57)**	1.21 (0.94-1.57)
Warmth behind ear	0.96 (0.72-1.27)	1.15 (0.90-1.45)	**0.66 (0.47-0.93)**
Warmth on ear	1.00 (0.77-1.31)	1.24 (0.99-1.55)	0.77 (0.56-1.06)
Burning skin	1.03 (0.74-1.43)	1.20 (0.91-1.58)	1.00 (0.70-1.42)

Tingling/tightness	1.03 (0.67-1.59)	1.36 (0.95-1.94)	1.04 (0.65-1.65)
Other	1.39 (0.98-1.98)	1.16 (0.84-1.60)	0.81 (0.52-1.25)

In bold $p<0.05$

Table 7. Crude ORs and in brackets 95% confidence intervals for different symptoms with respect to geographical location. The reference category is "largest cities".

	OR (95% C.I.)		
	Norway	Sweden	
Symptoms	Other places	Southern Sweden	Northern Sweden
Dizziness	1.23 (0.93-1.62)	0.85 (0.58-1.24)	1.12 (0.75-1.69)
Discomfort	1.27 (0.92-1.77)	1.27 (0.88-1.82)	1.09 (0.72-1.64)
Concentration	1.19 (0.92-1.55)	0.94 (0.74-1.19)	1.00 (0.85-1.43)
Memory loss	**1.44 (1.05-1.97)**	**1.40 (1.02-1.92)**	1.28 (0.90-1.82)
Fatigue	1.05 (0.87-1.28)	1.18 (0.97-1.43)	**1.24 (1.00-1.54)**
Headaches	**1.45 (1.18-1.80)**	1.08 (0.86-1.35)	1.24 (0.97-1.59)
Warmth behind ear	1.13 (0.95-1.35)	0.96 (0.73-1.25)	**1.34 (1.00-1.79)**
Warmth on ear	1.11 (0.94-1.31)	0.92 (0.72-1.18)	1.26 (0.96-1.65)
Burning skin	1.25 (0.97-1.60)	0.92 (0.68-1.24)	1.31 (0.95-1.81)
Tingling/tightness	1.14 (0.81-1.62)	0.95 (0.65-1.38)	1.01 (0.67-1.54)
Other	1.07 (0.75-1.52)	0.88 (0.63-1.21)	0.79 (0.55-1.15)

In bold $p<0.05$

Table 8. Crude ORs and in brackets 95% confidence intervals for different symptoms with respect to psychosocial factors. The reference category is "low psychosocial work load".

	OR (95% C.I.)			
	Norway		Sweden	
Symptoms	Medium	High	Medium	High
Dizziness	**1.78 (1.27-2.49)**	**1.85 (1.24-2.78)**	**1.44 (1.02-2.03)**	**3.20 (2.22-4.63)**
Discomfort	**2.01 (1.30-3.12)**	**3.32 (2.06-5.35)**	**1.52 (1.11-2.08)**	**3.41 (2.45-4.76)**
Concentration	**1.35 (1.00-1.84)**	**1.81 (1.26-2.59)**	**1.44 (1.17-1.78)**	**3.28 (2.60-4.12)**
Memory loss	1.21 (0.83-1.76)	**1.97 (1.29-2.99)**	**1.35 (1.05-1.72)**	**2.23 (1.67-2.96)**
Fatigue	**1.45 (1.15-1.82)**	**2.41 (1.85-3.16)**	**1.56 (1.32-1.83)**	**2.59 (2.14-3.13)**
Headaches	1.21 (0.94-1.55)	**1.95 (1.46-2.61)**	**1.62 (1.35-1.96)**	**2.40 (1.92-2.99)**
Warmth behind ear	1.19 (0.97-1.45)	1.12 (0.86-1.44)	**1.50 (1.20-1.88)**	**2.29 (1.77-2.98)**
Warmth on ear	1.09 (0.90-1.32)	1.15 (0.91-1.47)	**1.27 (1.03-1.56)**	**2.11 (1.66-2.69)**
Burning skin	**1.36 (1.01-1.81)**	**1.53 (1.08-2.18)**	**1.58 (1.22-2.05)**	**2.42 (1.79-3.26)**
Tingling/tightness	1.47 (0.97-2.22)	1.61 (0.98-2.66)	**1.66 (1.20-2.31)**	**2.40 (1.63-3.53)**
Other	1.42 (0.91-2.21)	**2.50 (1.55-4.05)**	**1.56 (1.17-2.09)**	**2.45 (1.75-3.44)**

In bold $p<0.05$

Table 9. Crude ORs and in brackets 95% confidence intervals for different symptoms with respect to amount of VDT-work. The reference category is "< 1 hrs/day".

A: Norway

	OR (95% C.I.)		
Symptoms	1-4 h/d	> 4 h/d	No VDT work
Dizziness	0.95 (0.64-1.40)	1.04 (0.65-1.68)	1.20 (0.76-1.87)
Discomfort	1.25 (0.76-2.04)	1.51 (0.85-2.67)	1.25 (0.70-2.23)
Concentration	0.90 (0.63-1.29)	1.32 (0.87-1.99)	0.84 (0.54-1.30)
Memory loss	0.91 (0.59-1.39)	1.37 (0.84-2.24)	0.74 (0.43-1.28)
Fatigue	1.07 (0.81-1.41)	1.36 (0.98-1.88)	1.19 (0.86-1.65)
Headaches	1.13 (0.83-1.53)	1.27 (0.88-1.83)	1.09 (0.76-1.57)
Warmth behind ear	1.04 (0.81-1.34)	0.95 (0.69-1.30)	1.21 (0.90-1.62)
Warmth on ear	1.15 (0.91-1.46)	1.07 (0.80-1.44)	1.23 (0.92-1.63)
Burning skin	1.02 (0.72-1.45)	0.92 (0.59-1.42)	1.15 (0.76-1.73)
Tingling/tightness	0.98 (0.61-1.57)	0.78 (0.42-1.46)	1.09 (0.62-1.92)
Other	1.19 (0.73-1.95)	1.06 (0.57-1.96)	1.00 (0.54-1.84)

In bold p<0.05

B: Sweden

	OR (95% C.I.)		
Symptoms	1-4 h/d	> 4 h/d	No VDT work
Dizziness	1.41 (0.95-2.09)	**1.81 (1.14-2.87)**	**1.57 (1.00-2.46)**
Discomfort	1.12 (0.81-1.56)	**1.53 (1.04-2.25)**	0.91 (0.60-1.37)
Concentration	1.24 (0.99-1.57)	**1.57 (1.20-2.07)**	0.86 (0.64-1.16)
Memory loss	0.94 (0.72-1.23)	0.79 (0.55-1.14)	1.03 (0.75-1.41)
Fatigue	1.11 (0.93-1.33)	**1.44 (1.16-1.79)**	1.10 (0.88-1.36)
Headaches	1.10 (0.89-1.36)	**1.53 (1.19-1.96)**	1.07 (0.83-1.38)
Warmth behind ear	0.95 (0.75-1.21)	1.16 (0.86-1.55)	**0.68 (0.50-0.93)**
Warmth on ear	1.13 (0.89-1.42)	**1.45 (1.10-1.92)**	0.79 (0.59-1.06)
Burning skin	1.29 (0.96-1.73)	**2.13 (1.54-2.96)**	0.79 (0.54-1.16)
Tingling/tightness	1.41 (0.96-2.09)	**2.48 (1.62-3.80)**	0.95 (0.58-1.56)
Other	1.16 (0.84-1.61)	**1.94 (1.35-2.80)**	**0.63 (0.40-0.99)**

In bold p<0.05

Table 10. Crude ORs and in brackets 95% confidence intervals and 95% confidence intervals for time with mobile phone. The reference category is "< 13 months".

	OR (95% C.I.)			
	Norway		Sweden	
Symptoms	13 – 24 months	> 24 months	13 – 24 months	> 24 months
Dizziness	**0.62 (0.40-0.96)**	0.78 (0.49-1.22)	0.81 (0.57-1.17)	0.97 (0.69-1.37)
Discomfort	0.78 (0.46-1.30)	0.93 (0.54-1.60)	0.96 (0.69-1.34)	1.19 (0.86-1.62)
Concentration	0.91 (0.62-1.32)	0.68 (0.43-1.08)	**0.75 (0.60-0.94)**	0.81 (0.66-1.00)
Memory loss	0.97 (0.59-1.59)	1.50 (0.93-2.45)	0.77 (0.59-1.02)	0.96 (0.75-1.25)
Fatigue	0.84 (0.63-1.12)	1.05 (0.77-1.41)	0.93 (0.78-1.11)	0.99 (0.84-1.18)
Headaches	0.92 (0.67-1.27)	1.17 (0.83-1.63)	0.87 (0.71-1.07)	0.98 (0.81-1.20)
Warmth behind ear	1.03 (0.80-1.34)	1.09 (0.82-1.45)	0.86 (0.67-1.10)	0.99 (0.78-1.25)
Warmth on ear	1.04 (0.81-1.33)	1.22 (0.93-1.59)	**0.74 (0.58-0.94)**	0.99 (0.80-1.23)
Burning skin	1.15 (0.80-1.65)	1.06 (0.71-1.60)	0.88 (0.66-1.17)	1.11 (0.85-1.45)
Tingling/tightness	0.91 (0.55-1.53)	0.80 (0.44-1.44)	1.17 (0.81-1.68)	1.09 (0.76-1.56)
Other	0.78 (0.46-1.35)	0.98 (0.56-1.71)	0.85 (0.62-1.16)	0.92 (0.68-1.25)

In bold $p<0.05$

3.4 Symptoms versus exposure factors

Our main hypothesis was that the users of GSM MPs experienced more symptoms than NMT users. To find out whether there was a difference between the prevalence of symptoms in the two groups, we made a comparison between the users of the different transmitter systems. The NMT users were used as the reference category, for further details see Table 11. For most symptoms there were no statistically significant differences between the different transmitter systems with regard to the prevalence of symptoms. Our hypothesis was therefore falsified. However, in both Norway and Sweden the study indicated a statistically significant lower risk for warmth sensations behind/around or on the ear for GSM users compared to NMT users. The same trend was also seen in the Swedish data for headaches. The effect of transmitter system and *number of calls* or *calling time* per day was analysed by using the category with the lowest *number of calls*/the shortest *calling time* as the reference category irrespective of the transmitter system. Crude and adjusted ORs are given in Tables 12 and 13.

An increased risk was observed for most symptoms for groups with longer *calling times* and higher *numbers of calls* per day. The effect was particularly pronounced for the warmth sensation variables. Among symptoms from the nervous system, the most pronounced effects were seen for headaches and fatigue.

Table 11. Crude (C) and adjusted (A) ORs and in brackets 95% confidence intervals for different symptoms with respect to transmitter system. The reference category is "NMT 900". Factors for which the ORs for each symptom are adjusted, are given in Appendix E.

		OR (95% C.I.)			
		Norway		Sweden	
Symptoms		GSM	Mixed	GSM	Mixed
Dizziness	C	1.03 (0.72-1.47)	1.28 (0.91-1.81)	0.95 (0.67-1.36)	0.97 (0.69-1.36)
	A	1.03 (0.71-1.47)	0.89 (0.61-1.30)	1.01 (0.68-1.51)	1.04 (0.72-1.49)
Discomfort	C	0.98 (0.63-1.50)	1.43 (0.96-2.15)	1.37 (0.96-1.97)	**1.70 (1.21-2.38)**
	A	1.00 (0.64-1.56)	1.14 (0.72-1.80)	1.31 (0.91-1.90)	1.27 (0.88-1.83)
Concentration	C	1.35 (0.97-1.88)	1.38 (0.99-1.92)	0.90 (0.72-1.13)	1.10 (0.89-1.36)
	A	1.35 (0.97-1.90)	1.06 (0.73-1.52)	0.86 (0.67-1.11)	0.93 (0.73-1.18)
Memory loss	C	1.07 (0.71-1.60)	1.41 (0.96-2.08)	0.92 (0.69-1.23)	1.29 (0.99-1.67)
	A	1.06 (0.70-1.59)	1.06 (0.69-1.62)	0.91 (0.67-1.22)	1.01 (0.76-1.35)
Fatigue	C	1.05 (0.83-1.34)	1.17 (0.92-1.49)	0.87 (0.72-1.04)	**1.21 (1.03-1.44)**
	A	1.07 (0.83-1.37)	0.82 (0.62-1.07)	0.85 (0.70-1.03)	1.03 (0.85-1.23)
Headache	C	0.86 (0.66-1.13)	1.15 (0.89-1.48)	0.84 (0.68-1.04)	1.10 (0.91-1.34)
	A	0.94 (0.71-1.24)	0.85 (0.64-1.13)	**0.78 (0.63-0.97)**	0.84 (0.68-1.04)
Warmth behind ear	C	**0.66 (0.53-0.83)**	0.88 (0.71-1.09)	**0.73 (0.57-0.95)**	1.21 (0.96-1.52)
	A	**0.71 (0.56-0.91)**	**0.51 (0.39-0.66)**	**0.74 (0.55-0.99)**	**0.68 (0.52-0.90)**
Warmth on ear	C	**0.67 (0.54-0.83)**	0.92 (0.75-1.13)	**0.66 (0.51-0.84)**	1.19 (0.96-1.47)
	A	**0.71 (0.56-0.90)**	**0.58 (0.45-0.74)**	**0.56 (0.43-0.73)**	**0.61 (0.48-0.78)**
Burning skin	C	0.77 (0.56-1.05)	1.04 (0.77-1.40)	0.95 (0.66-1.37)	1.13 (0.80-1.59)
	A	0.83 (0.60-1.15)	**0.61 (0.43-0.85)**	0.99 (0.72-1.36)	0.90 (0.67-1.22)
Tingling/tightness	C	0.84 (0.54-1.31)	1.09 (0.72-1.67)	1.02 (0.73-1.41)	1.19 (0.87-1.62)
	A	0.90 (0.58-1.40)	0.73 (0.47-1.16)	0.79 (0.54-1.16)	0.89 (0.61-1.29)
Other	C	0.87 (0.55-1.37)	1.29 (0.84-1.98)	1.01 (0.75-1.35)	1.25 (0.96-1.64)
	A	0.85 (0.54-1.35)	1.00 (0.63-1.59)	0.91 (0.65-1.28)	0.92 (0.66-1.29)

In bold $p<0.05$

Table 12. Crude (C) and adjusted (A) ORs and in brackets 95% confidence intervals for calling time. The reference category is calling time less than 2 mins/day. Factors for which the ORs for each symptom are adjusted, are given in Appendix E. A:Norway, B: Sweden.

A: Norway

			NMT 900			GSM			Mixed		
Calling time/day		< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
Number of people		148	412	332	65	528	352	45	161	450	323
			OR (95% C.I.)								
			NMT 900			GSM			Mixed		
Symptoms		< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
Dizziness	C	1.0	1.67 (0.62-4.47)	2.22 (0.83-5.94)	**7.74 (2.65-22.6)**	1.58 (0.60-4.16)	**2.72 (1.04-7.15)**	**8.06 (2.59-25.1)**	1.87 (0.62-5.60)	2.38 (0.91-6.19)	**3.55 (1.36-9.24)**
	A	1.0	1.63 (0.61-4.39)	1.90 (0.71-5.14)	**6.92 (2.35-20.4)**	1.47 (0.56-3.90)	2.24 (0.85-5.95)	**6.36 (1.99-20.4)**	1.85 (0.61-5.56)	2.15 (0.82-5.63)	**3.02 (1.15-7.93)**
Discomfort	C	1.0	0.88 (0.34-2.32)	1.19 (0.46-3.11)	**3.75 (1.28-11.0)**	1.06 (0.42-2.66)	1.04 (0.39-2.73)	2.28 (0.61-8.45)	1.06 (0.35-3.23)	1.49 (0.60-3.68)	2.14 (0.86-5.29)
	A	1.0	0.79 (0.30-2.14)	0.73 (0.26-2.02)	**3.41 (1.12-10.4)**	0.80 (0.31-2.07)	0.83 (0.31-2.25)	2.15 (0.56-8.24)	0.77 (0.23-2.61)	1.18 (0.47-2.99)	1.80 (0.71-4.57)
Concentration	C	1.0	0.77 (0.35-1.66)	1.36 (0.65-2.87)	2.19 (0.84-5.67)	1.27 (0.62-2.58)	1.84 (0.90-3.78)	1.70 (0.55-5.26)	0.81 (0.32-2.04)	1.29 (0.63-2.65)	2.04 (0.99-4.19)
	A	1.0	0.79 (0.37-1.72)	1.32 (0.63-2.80)	2.23 (0.86-5.81)	1.23 (0.60-2.52)	1.82 (0.89-3.74)	1.58 (0.51-4.91)	0.81 (0.32-2.06)	1.29 (0.62-2.65)	1.97 (0.96-4.05)
Memory loss	C	1.0	1.13 (0.44-2.88)	1.35 (0.52-3.48)	2.37 (0.74-7.66)	1.16 (0.47-2.88)	1.63 (0.65-4.09)	2.28 (0.61-8.45)	1.22 (0.41-3.60)	1.55 (0.63-3.82)	2.31 (0.94-5.69)
	A	1.0	1.18 (0.46-3.03)	1.37 (0.53-3.54)	2.51 (0.77-8.13)	1.17 (0.47-2.90)	1.62 (0.65-4.08)	2.13 (0.57-7.93)	1.24 (0.42-3.67)	1.50 (0.60-3.71)	2.31 (0.94-5.72)
Fatigue	C	1.0	1.14 (0.65-2.01)	**1.82 (1.04-3.19)**	**2.52 (1.20-5.29)**	1.20 (0.69-2.07)	**1.80 (1.03-3.14)**	**4.74 (2.19-10.3)**	1.13 (0.58-2.19)	1.35 (0.78-2.36)	**2.59 (1.49-4.50)**
	A	1.0	1.14 (0.64-2.02)	1.59 (0.89-2.81)	**2.47 (1.16-5.24)**	1.10 (0.63-1.92)	1.55 (0.88-2.74)	**4.14 (1.86-9.22)**	1.01 (0.51-2.01)	1.24 (0.70-2.17)	**2.22 (1.26-3.90)**
Headaches	C	1.0	1.85 (0.85-4.06)	**3.92 (1.83-8.43)**	**6.60 (2.69-16.2)**	2.00 (0.93-4.31)	**3.05 (1.41-6.60)**	**7.00 (2.68-18.3)**	1.77 (0.73-4.31)	**3.17 (1.49-6.77)**	**4.28 (1.99-9.17)**
	A	1.0	1.81 (0.82-3.98)	**3.31 (1.53-7.18)**	**6.36 (2.57-15.8)**	1.94 (0.90-4.20)	**2.69 (1.24-5.88)**	**6.31 (2.35-17.0)**	1.79 (0.73-4.39)	**3.01 (1.40-6.47)**	**3.77 (1.74-8.16)**

			OR (95% C.I.)								
			NMT 900			GSM			Mixed		
Symptoms		< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
Warmth behind ear	C	1.0	**3.08 (1.54-6.12)**	**6.02 (3.04-11.9)**	**21.8 (9.64-49.1)**	**2.08 (1.04-4.14)**	**4.26 (2.14-8.47)**	**20.4 (8.49-49.9)**	1.50 (0.66-3.42)	**3.59 (1.82-7.09)**	**6.77 (3.42-13.4)**
	A	1.0	**2.42 (1.20-4.89)**	**4.29 (2.13-8.62)**	**18.1 (7.83-41.8)**	1.68 (0.83-3.40)	**2.93 (1.45-5.92)**	**16.0 (6.34-40.4)**	1.40 (0.60-3.24)	**2.77 (1.38-5.54)**	**5.03 (2.51-10.1)**
Warmth on ear	C	1.0	**2.99 (1.58-5.65)**	**6.58 (3.50-12.4)**	**14.8 (6.85-31.8)**	1.88 (0.99-3.56)	**5.14 (2.73-9.67)**	**9.77 (4.25-22.5)**	1.77 (0.84-3.71)	**3.97 (2.12-7.43)**	**6.20 (3.29-11.7)**
	A	1.0	**2.65 (1.35-5.18)**	**5.30 (2.72-10.3)**	**12.4 (5.52-27.8)**	1.65 (0.84-3.24)	**3.94 (2.02-7.71)**	**8.37 (3.41-20.6)**	1.86 (0.86-4.06)	**3.31 (1.71-6.42)**	**5.13 (2.63-10.0)**
Burning skin	C	1.0	1.51 (0.56-4.09)	**4.70 (1.83-12.1)**	**12.5 (4.45-35.3)**	1.58 (0.60-4.16)	**3.72 (1.44-9.61)**	**10.3 (3.38-31.1)**	1.47 (0.47-4.61)	**3.13 (1.22-8.05)**	**4.94 (1.92-12.7)**
	A	1.0	1.44 (0.53-3.94)	**4.29 (1.65-11.1)**	**11.8 (4.14-33.6)**	1.56 (0.59-4.13)	**3.48 (1.33-9.07)**	**8.42 (2.70-26.2)**	1.53 (0.49-4.81)	**2.89 (1.11-7.48)**	**4.31 (1.66-11.2)**
Tingling/tightness	C	1.0	1.92 (0.55-6.70)	2.92 (0.85-10.0)	**5.75 (1.44-23.0)**	1.11 (0.31-3.98)	3.17 (0.94-10.8)	**4.65 (1.00-21.6)**	1.53 (0.36-6.50)	2.21 (0.65-7.56)	**4.01 (1.19-13.5)**
	A[1)]										
Other	C	1.0	0.82 (0.31-2.18)	1.19 (0.46-3.11)	2.37 (0.74-7.66)	0.78 (0.30-2.01)	1.04 (0.39-2.73)	1.09 (0.21-5.57)	1.06 (0.35-3.23)	1.20 (0.48-3.02)	1.88 (0.75-4.70)
	A	1.0	0.86 (0.32-2.30)	1.21 (0.46-3.18)	2.53 (0.78-8.24)	0.77 (0.30-2.01)	0.97 (0.36-2.61)	1.05 (0.20-5.46)	1.06 (0.35-3.24)	1.16 (0.45-2.93)	1.72 (0.68-4.36)

In bold $p<0.05$ 1: No factor to adjust for.

B: Sweden

		NMT 900			GSM			Mixed		
Calling time/day	< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
Number of people	813	1076	476	52	1457	683	77	971	1518	617

			OR (95% C.I.)								
			NMT 900			GSM			Mixed		
Symptoms		< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
Dizziness	C	1.0	0.88 (0.50-1.55)	1.27 (0.67-2.40)	1.37 (0.31-5.98)	0.87 (0.51-1.48)	1.30 (0.73-2.32)	1.39 (0.41-4.74)	0.65 (0.35-1.21)	0.98 (0.58-1.63)	1.33 (0.74-2.39)
	A	1.0	0.81 (0.44-1.49)	1.07 (0.53-2.17)	1.17 (0.26-5.25)	0.85 (0.48-1.52)	1.30 (0.70-2.43)	1.20 (0.34-4.21)	0.62 (0.32-1.22)	0.99 (0.56-1.72)	1.34 (0.71-2.52)
Discomfort	C	1.0	1.20 (0.65-2.22)	1.31 (0.63-2.73)	1.87 (0.42-8.31)	1.39 (0.78-2.45)	**2.45 (1.36-4.42)**	1.89 (0.54-6.61)	1.08 (0.57-2.05)	**1.82 (1.05-3.15)**	**4.21 (2.41-7.36)**
	A	1.0	1.34 (0.71-2.54)	1.24 (0.57-2.68)	1.69 (0.37-7.65)	1.41 (0.77-2.57)	**2.38 (1.28-4.44)**	1.59 (0.45-5.68)	1.22 (0.63-2.37)	**1.88 (1.05-3.35)**	**4.07 (2.25-7.35)**
Concentration	C	1.0	1.15 (0.77-1.71)	**2.05 (1.34-3.14)**	2.33 (0.94-5.76)	1.14 (0.78-1.65)	**1.94 (1.31-2.89)**	1.79 (0.77-4.12)	1.43 (0.97-2.11)	1.38 (0.96-1.99)	**2.43 (1.65-3.60)**
	A	1.0	1.18 (0.76-1.85)	**2.24 (1.40-3.59)**	1.81 (0.67-4.93)	1.20 (0.79-1.83)	**1.90 (1.22-2.96)**	1.36 (0.54-3.43)	**1.57 (1.02-2.42)**	**1.53 (1.02-2.30)**	**2.47 (1.59-3.82)**
Memory loss	C	1.0	1.12 (0.70-1.82)	1.43 (0.82-2.49)	1.65 (0.49-5.62)	1.08 (0.68-1.70)	**1.64 (1.00-2.67)**	1.09 (0.33-3.68)	1.16 (0.71-1.89)	**1.54 (1.00-2.38)**	**2.75 (1.73-4.35)**
	A	1.0	1.24 (0.76-2.05)	1.65 (0.93-2.91)	1.73 (0.50-5.94)	1.16 (0.72-1.87)	**1.74 (1.04-2.91)**	1.18 (0.35-4.02)	1.21 (0.72-2.02)	**1.72 (1.10-2.71)**	**3.01 (1.86-4.88)**
Fatigue	C	1.0	1.24 (0.91-1.70)	**2.08 (1.47-2.93)**	**2.52 (1.21-5.25)**	1.20 (0.89-1.61)	**1.69 (1.22-2.35)**	1.40 (0.67-2.93)	**1.44 (1.05-1.97)**	**1.70 (1.28-2.26)**	**2.67 (1.95-3.65)**
	A	1.0	1.33 (0.94-1.89)	**2.26 (1.54-3.32)**	**2.32 (1.06-5.07)**	1.25 (0.89-1.75)	**1.80 (1.25-2.59)**	1.40 (0.65-3.00)	**1.55 (1.10-2.20)**	**1.93 (1.40-2.67)**	**2.92 (2.05-4.15)**
Headaches	C	1.0	**1.48 (1.01-2.15)**	**2.61 (1.74-3.91)**	**2.71 (1.16-6.36)**	1.29 (0.89-1.85)	**2.15 (1.46-3.17)**	**2.91 (1.43-5.89)**	1.19 (0.80-1.77)	**2.07 (1.47-2.92)**	**3.02 (2.07-4.40)**
	A	1.0	**1.81 (1.22-2.69)**	**3.24 (2.12-4.95)**	**3.40 (1.43-8.12)**	**1.49 (1.02-2.19)**	**2.50 (1.66-3.75)**	**2.83 (1.37-5.85)**	1.48 (0.98-2.24)	**2.66 (1.84-3.83)**	**3.68 (2.47-5.49)**
Warmth behind ear	C	1.0	**4.28 (2.01-9.15)**	**13.4 (6.33-28.4)**	**33.5 (13.1-85.5)**	**2.69 (1.25-5.80)**	**10.4 (4.94-21.8)**	**28.5 (11.8-68.7)**	**3.65 (1.68-7.92)**	**7.93 (3.85-16.3)**	**17.4 (8.37-36.1)**

			OR (95% C.I.)								
			NMT 900			GSM			Mixed		
Symptoms		< 2mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d	2-15 mins/d	15-60 mins/d	> 60 mins/d
	A	1.0	**4.28 (1.90-9.64)**	**10.7 (4.74-24.1)**	**30.3 (11.2-81.8)**	**2.63 (1.16-5.98)**	**9.00 (4.05-20.0)**	**21.9 (8.46-56.7)**	**3.74 (1.64-8.56)**	**7.42 (3.42-16.1)**	**14.4 (6.54-31.6)**
Warmth on ear	C	1.0	**5.00 (2.48-10.1)**	**13.2 (6.50-26.6)**	**39.0 (16.2-94.0)**	**2.42 (1.17-4.99)**	**9.87 (4.91-19.8)**	**26.8 (11.6-62.0)**	**3.28 (1.58-6.84)**	**9.06 (4.62-17.8)**	**17.0 (8.55-33.7)**
	A	1.0	**6.18 (2.92-13.1)**	**15.3 (7.19-32.5)**	**47.8 (18.9-121)**	**2.73 (1.26-5.91)**	**10.2 (4.81-21.5)**	**22.4 (9.10-55.0)**	**3.93 (1.80-8.56)**	**10.7 (5.19-22.1)**	**19.0 (9.02-39.4)**
Burning skin	C	1.0	0.86 (0.51-1.44)	**1.88 (1.11-3.19)**	**3.65 (1.44-9.26)**	0.89 (0.55-1.44)	**1.97 (1.22-3.20)**	**3.71 (1.68-8.17)**	1.11 (0.67-1.83)	1.35 (0.87-2.12)	**3.02 (1.90-4.79)**
	A	1.0	1.05 (0.61-1.81)	**2.12 (1.20-3.74)**	**4.17 (1.59-11.0)**	1.06 (0.64-1.77)	**2.34 (1.40-3.92)**	**2.77 (1.13-6.75)**	1.27 (0.74-2.16)	**1.65 (1.02-2.67)**	**3.64 (2.22-5.99)**
Tingling/tightness	C	1.0	0.72 (0.40-1.30)	1.19 (0.62-2.28)	0.67 (0.09-5.08)	0.72 (0.42-1.25)	1.41 (0.80-2.49)	1.88 (0.63-5.58)	0.80 (0.44-1.44)	0.95 (0.57-1.60)	**1.94 (1.13-3.34)**
	A	1.0	0.94 (0.51-1.74)	1.57 (0.80-3.08)	0.83 (0.11-6.35)	0.73 (0.41-1.32)	1.60 (0.89-2.89)	1.32 (0.38-4.57)	1.01 (0.55-1.86)	1.23 (0.71-2.13)	**2.36 (1.33-4.19)**
Other	C	1.0	1.36 (0.77-2.40)	1.83 (0.97-3.46)	0.82 (0.11-6.23)	1.18 (0.68-2.05)	**2.25 (1.28-3.98)**	2.29 (0.76-6.90)	0.88 (0.47-1.66)	1.81 (1.07-3.04)	**2.74 (1.56-4.80)**
	A	1.0	1.34 (0.75-2.40)	**1.94 (1.02-3.69)**	0.76 (0.10-5.84)	1.13 (0.65-1.97)	**1.95 (1.10-3.48)**	1.88 (0.62-5.74)	0.88 (0.46-1.68)	**1.88 (1.11-3.17)**	**2.61 (1.48-4.60)**

In bold $p<0.05$

Table 13. Crude (C) and adjusted (A) ORs and in brackets 95% confidence intervals for number of calls per day. The reference category is less than 2 calls/day. Factors for which the ORs for each symptom are adjusted, are given in Appendix E. A:Norway, B: Sweden.

A: Norway

		NMT 900		GSM		Mixed	
Number of calls	< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
Number of people	265	236	534	343	509	163	767

		OR (95% C.I.)					
		NMT 900		GSM		Mixed	
Symptoms	< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
Dizziness C	1.0	1.41 (0.55-3.63)	**3.16 (1.47-6.78)**	**2.40 (1.06-5.43)**	**3.02 (1.40-6.50)**	2.08 (0.80-5.39)	**3.31 (1.57-6.96)**
A	1.0	1.39 (0.54-3.60)	**2.97 (1.38-6.41)**	**2.27 (1.00-5.16)**	**2.64 (1.22-5.74)**	2.14 (0.82-5.55)	**3.04 (1.44-6.43)**
Discomfort C	1.0	0.95 (0.32-2.88)	**2.42 (1.06-5.54)**	**2.38 (1.00-5.70)**	1.57 (0.66-3.75)	2.14 (0.78-5.85)	**2.66 (1.19-5.94)**
A	1.0	0.97 (0.32-2.94)	2.23 (0.96-5.16)	2.26 (0.94-5.43)	1.34 (0.55-3.24)	2.23 (0.81-6.13)	**2.42 (1.08-5.45)**
Concentration C	1.0	1.40 (0.66-2.97)	1.73 (0.92-3.27)	**1.98 (1.02-3.84)**	**2.42 (1.30-4.51)**	1.26 (0.54-2.93)	**2.27 (1.24-4.15)**
A	1.0	1.51 (0.70-3.28)	1.76 (0.91-3.40)	**2.06 (1.04-4.09)**	**2.40 (1.25-4.58)**	1.37 (0.58-3.25)	**2.29 (1.22-4.29)**
Memory loss C	1.0	1.12 (0.48-2.63)	1.42 (0.70-2.87)	1.34 (0.63-2.87)	1.38 (0.68-2.82)	0.73 (0.25-2.13)	**1.98 (1.03-3.83)**
A	1.0	1.17 (0.50-2.76)	1.49 (0.73-3.01)	1.35 (0.63-2.89)	1.39 (0.68-2.84)	0.73 (0.25-2.14)	**1.98 (1.02-3.83)**
Fatigue C	1.0	1.38 (0.79-2.40)	**2.32 (1.47-3.67)**	**1.78 (1.08-2.92)**	**2.26 (1.42-3.57)**	1.35 (0.73-2.48)	**2.39 (1.54-3.71)**
A	1.0	1.51 (0.86-2.65)	**2.41 (1.50-3.87)**	**1.83 (1.10-3.05)**	**2.24 (1.39-3.61)**	1.48 (0.80-2.77)	**2.36 (1.49-3.72)**
Headaches C	1.0	**2.07 (1.03-4.19)**	**4.17 (2.29-7.60)**	**2.18 (1.13-4.21)**	**3.69 (2.01-6.75)**	**2.84 (1.38-5.84)**	**3.85 (2.14-6.94)**
A	1.0	1.95 (0.95-4.00)	**4.08 (2.22-7.50)**	**2.26 (1.16-4.40)**	**3.53 (1.91-6.54)**	**2.99 (1.44-6.20)**	**3.78 (2.08-6.88)**

			OR (95% C.I.)					
			NMT 900		GSM		Mixed	
Symptoms		< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
Warmth behind ear	C	1.0	**3.03 (1.71-5.34)**	**5.87 (3.56-9.70)**	**1.79 (1.02-3.16)**	**4.59 (2.76-7.62)**	1.80 (0.93-3.48)	**4.51 (2.75-7.39)**
	A	1.0	**2.55 (1.40-4.65)**	**5.04 (2.98-8.53)**	1.63 (0.90-2.95)	**3.82 (2.25-6.50)**	1.69 (0.84-3.41)	**3.92 (2.34-6.56)**
Warmth on ear	C	1.0	3.43 (1.98-5.95)	**6.64 (4.07-10.8)**	**2.22 (1.29-3.82)**	**5.17 (3.16-8.48)**	**2.20 (1.18-4.11)**	**5.28 (3.26-8.54)**
	A	1.0	3.34 (1.86-6.00)	**6.03 (3.58-10.2)**	**2.08 (1.17-3.69)**	**4.67 (2.76-7.92)**	**2.18 (1.11-4.27)**	**4.91 (2.94-8.19)**
Burning skin	C	1.0	1.01 (0.42-2.43)	**3.82 (1.99-7.32)**	1.42 (0.67-3.01)	**2.89 (1.49-5.61)**	1.82 (0.78-4.23)	**3.01 (1.58-5.73)**
	A	1.0	1.03 (0.43-2.49)	**3.76 (1.94-7.28)**	1.43 (0.67-3.07)	**2.86 (1.46-5.63)**	2.00 (0.85-4.67)	**2.84 (1.48-5.47)**
Tingling/tightness	C	1.0	1.50 (0.51-4.39)	**2.83 (1.17-6.84)**	1.29 (0.46-3.58)	2.40 (0.98-5.88)	1.35 (0.41-4.51)	**2.61 (1.10-6.19)**
	A[1)]							
Other	C	1.0	1.50 (0.51-4.39)	2.29 (0.93-5.61)	1.69 (0.63-4.50)	1.93 (0.77-4.83)	**2.80 (1.00-7.85)**	**2.48 (1.04-5.91)**
	A	1.0	1.63 (0.51-5.22)	2.32 (0.87-6.23)	1.80 (0.62-5.20)	1.91 (0.70-5.20)	3.03 (0.99-9.26)	**2.60 (1.01-6.71)**

In bold $p<0.05$ 1: No factor to adjust for.

B: Sweden

		NMT 900		GSM		Mixed	
Number of calls	< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
Number of people	1187	634	851	932	1071	782	2286

			OR (95% C.I.)					
			NMT 900		GSM		Mixed	
Symptoms		< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
Dizziness	C	1.0	0.87 (0.47-1.63)	1.14 (0.67-1.92)	0.99 (0.59-1.69)	1.15 (0.70-1.88)	0.85 (0.47-1.53)	1.09 (0.71-1.67)

			OR (95% C.I.)					
			NMT 900		GSM		Mixed	
Symptoms		< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
	A	1.0	0.77 (0.39-1.51)	1.00 (0.56-1.78)	0.97 (0.54-1.74)	1.16 (0.67-1.98)	0.90 (0.49-1.64)	1.08 (0.67-1.73)
Discomfort	C	1.0	1.14 (0.62-2.10)	0.95 (0.52-1.70)	1.42 (0.85-2.39)	**1.69 (1.04-2.74)**	1.09 (0.61-1.94)	**2.09 (1.37-3.19)**
	A	1.0	1.30 (0.69-2.45)	0.98 (0.53-1.82)	1.57 (0.91-2.71)	**1.74 (1.04-2.91)**	1.23 (0.67-2.25)	**2.24 (1.43-3.52)**
Concentration	C	1.0	1.46 (0.98-2.18)	**1.79 (1.26-2.55)**	1.27 (0.87-1.84)	**1.75 (1.25-2.46)**	**1.59 (1.09-2.30)**	**1.78 (1.32-2.40)**
	A	1.0	1.49 (0.96-2.31)	**1.79 (1.21-2.66)**	1.18 (0.78-1.80)	**1.75 (1.21-2.54)**	**1.63 (1.09-2.44)**	**1.86 (1.33-2.59)**
Memory loss	C	1.0	1.35 (0.80-2.28)	**1.75 (1.11-2.76)**	1.36 (0.85-2.18)	**1.82 (1.18-2.79)**	1.45 (0.89-2.35)	**2.26 (1.55-3.29)**
	A	1.0	1.51 (0.88-2.58)	**2.01 (1.25-3.23)**	1.44 (0.88-2.37)	**2.02 (1.29-3.16)**	1.54 (0.93-2.56)	**2.55 (1.71-3.79)**
Fatigue	C	1.0	1.26 (0.91-1.75)	**1.85 (1.40-2.45)**	1.20 (0.90-1.62)	**1.61 (1.23-2.11)**	**1.45 (1.08-1.95)**	**2.05 (1.62-2.58)**
	A	1.0	1.39 (0.99-1.94)	**1.99 (1.49-2.67)**	1.25 (0.92-1.70)	**1.70 (1.28-2.26)**	**1.54 (1.13-2.09)**	**2.29 (1.78-2.93)**
Headaches	C	1.0	1.12 (0.77-1.63)	**1.76 (1.29-2.41)**	1.02 (0.72-1.43)	**1.51 (1.11-2.05)**	1.12 (0.79-1.60)	**1.75 (1.34-2.27)**
	A	1.0	1.29 (0.88-1.91)	**2.19 (1.57-3.04)**	1.16 (0.82-1.66)	**1.75 (1.27-2.41)**	1.28 (0.89-1.83)	**2.21 (1.67-2.92)**
Warmth behind ear	C	1.0	**2.09 (1.15-3.80)**	**6.15 (3.78-9.99)**	1.46 (0.81-2.65)	**5.08 (3.14-8.23)**	1.68 (0.92-3.05)	**5.64 (3.58-8.87)**
	A	1.0	**1.94 (1.01-3.73)**	**6.01 (3.55-10.2)**	1.38 (0.73-2.61)	**5.01 (2.98-8.40)**	1.67 (0.89-3.15)	**5.60 (3.43-9.14)**
Warmth on ear	C	1.0	**2.63 (1.50-4.59)**	**6.96 (4.35-11.1)**	**1.76 (1.01-3.07)**	**5.03 (3.13-8.06)**	1.75 (0.98-3.12)	**6.46 (4.16-10.1)**
	A	1.0	**3.23 (1.81-5.76)**	**8.84 (5.36-14.6)**	**1.86 (1.04-3.33)**	**5.43 (3.29-8.95)**	**1.95 (1.06-3.56)**	**7.80 (4.87-12.5)**
Burning skin	C	1.0	0.87 (0.51-1.49)	1.31 (0.85-2.04)	0.95 (0.59-1.51)	**1.61 (1.08-2.40)**	0.99 (0.61-1.60)	**1.71 (1.21-2.43)**

			OR (95% C.I.)					
			NMT 900		GSM		Mixed	
Symptoms		< 2 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d	2-4 calls/d	> 4 calls/d
	A	1.0	0.97 (0.55-1.70)	1.61 (1.00-2.58)	1.15 (0.71-1.88)	**1.94 (1.26-2.97)**	1.12 (0.68-1.86)	**2.12 (1.45-3.10)**
Tingling/tightness	C	1.0	0.56 (0.28-1.15)	1.06 (0.62-1.79)	0.81 (0.46-1.40)	1.15 (0.71-1.86)	0.73 (0.40-1.34)	1.27 (0.84-1.91)
	A	1.0	0.60 (0.28-1.27)	1.34 (0.78-2.32)	0.84 (0.47-1.49)	1.15 (0.69-1.91)	0.83 (0.45-1.54)	1.48 (0.96-2.28)
Other	C	1.0	0.96 (0.54-1.71)	1.24 (0.76-2.03)	1.09 (0.67-1.80)	1.28 (0.81-2.03)	0.86 (0.50-1.51)	**1.51 (1.02-2.23)**
	A	1.0	1.00 (0.55-1.80)	1.35 (0.81-2.24)	1.07 (0.65-1.78)	1.24 (0.77-1.98)	0.87 (0.49-1.54)	**1.63 (1.09-2.43)**

In bold $p<0.05$

3.5 Symptoms experienced in connection with mobile phone calls

People were asked whether symptoms had occurred or had been aggravated in connection with the use of a MP. We will primarily focus here on differences between different symptoms and between users of different transmitter systems. The relative number of respondents who marked that they had experienced various symptoms, no matter how often, in connection with the use of an MP is shown in Figure 11. Please note that Figure 7 shows the prevalence of symptoms experienced at least once a week (irrespective of MP use). In Sweden 13% and in Norway 30% of the respondents had experienced at least one symptom in connection with MP calls.

For each symptom the occurrence is shown in Figure 11. The histograms reveal that more Norwegian than Swedish respondents indicated that they had experienced symptoms in connection with MP calls. For both countries the symptoms most frequently experienced were a sensation of warmth on the ear as well as behind or around the ear. Other symptoms (*Other)* attributed to use of MPs were noted by less than 1% of the respondents in both countries. Ear, eye and neck problems were most commonly reported.

In addition to asking about symptoms experienced in connection with MP use, we asked whether symptoms occurred or were aggravated in connection with the use of ordinary phones and VDTs. To compare the symptoms experienced in connection with these devices, we have only selected people who worked with VDTs (see Figure 12).

More people attributed their symptoms to MP use than to the use of ordinary phones. According to paired sign tests the differences were statistically significant (p-value < 0.001) for all symptoms. When comparing MP use with VDT use, statistically significant differences for both countries were obtained for discomfort, warmth behind/around or on the ear (p-values < 0.001) with most people attributing their symptoms to the MP. In Sweden there were also significant differences for difficulties concentrating, fatigue and headaches, as well as burning skin and tingling/tightness of the skin, where the symptoms are more often connected to the use of VDTs than to the use of MPs. In the Norwegian data, fatigue and headaches showed insignificant differences between MP use and VDT use. For burning skin and tingling/tightness, however, the differences were statistically significant and most frequently attributed to MP use.

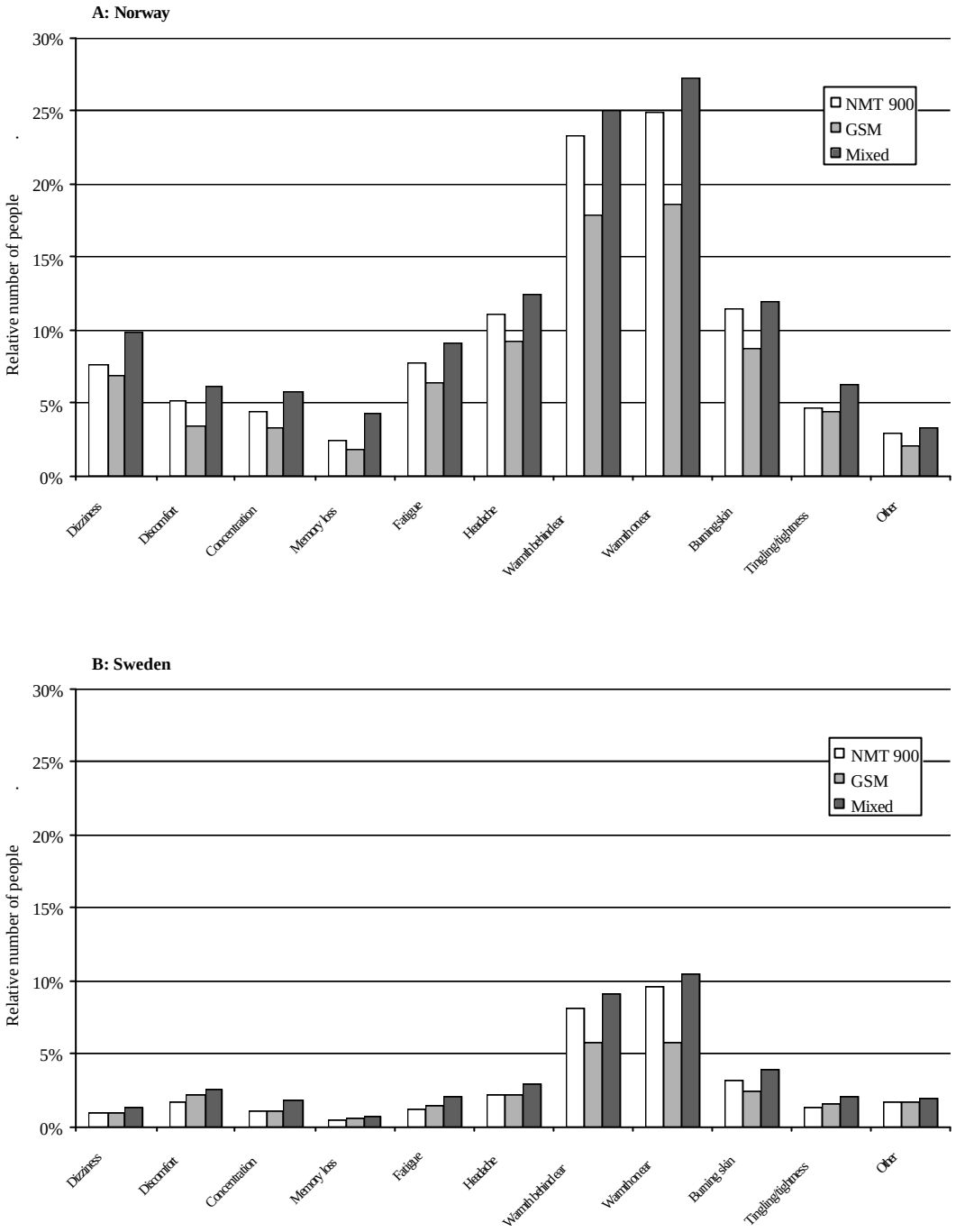

Figure 11. Relative numbers of people among the NMT 900 users, the GSM users, and the
"Mixed"-users respectively, who related their symptoms to the use of MPs. A: Norway, B: Sweden

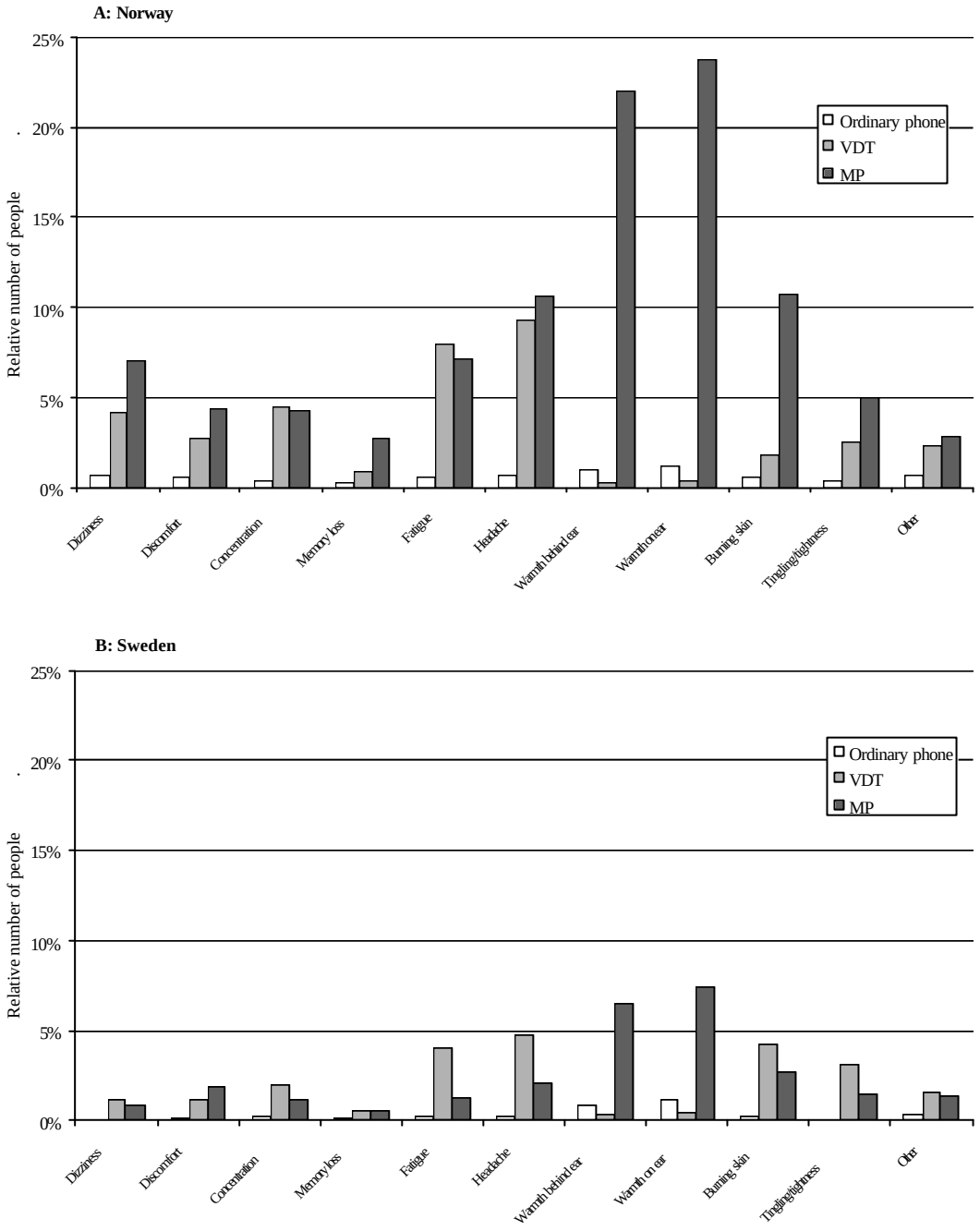

Figure 12. Relative numbers of people who experienced symptoms in connection with the use of MPs, ordinary phones, and VDTs respectively. Only people who worked with VDTs are included.
A: Norway, B: Sweden.

3.6 Non-respondent analysis

The non-respondent analysis revealed that the number of non-respondents who did not receive a questionnaire was relatively high: 21% in Norway and 43 % in Sweden. The most common reason for no response, however, was low priority. For both countries the relative number of people with symptoms attributed to MP use was almost equal for those who did not receive a questionnaire and for those who did not respond due to other reasons. The Swedish data suggests that the occurrence of symptoms was the same for respondents and non-respondents. The Norwegian data suggests that the respondents had a higher occurrence of symptoms attributed to the use of MPs than had the non-respondents. However, the distribution of potential risk factors (transmitter system, gender, geographical location and trade) was equally distributed for respondents and non-respondents in the Norwegian material. See Appendix D for more details.

4. Discussion

The hypothesis originally postulated, that GSM users had a higher prevalence of symptoms than NMT users, was falsified by the study. In fact, for some symptoms the results came out opposite to the hypothesis, i.e. fewer GSM users than NMT users experienced the phenomena of warmth sensations behind/around and on the ear. As a side finding, we also observed pronounced positive trends with respect to both *calling time* and *number of calls* per day for the warmth variables and for some of the symptoms from the nervous system. Several factors, emission as well as design, and other factors related to the use of mobile phones might have been responsible for the differences seen between the NMT users and the GSM users and for the increased prevalence of symptoms with increased c*alling time/number of calls*. The role of the different factors as well as the possible influence of methodological defectiveness and problems will be discussed.

4.1 Sensation of warmth and nervous system symptoms

Symptoms for which the results in both countries have shown a consistent increase in prevalence with increases in *calling time* and *number of calls* are fatigue, headaches, and the warmth sensation variables. Mechanisms underlying the warmth sensations of the pinna and the surrounding areas are not fully understood. Further studies are required to identify the experience of ”warmth”, whether it is a reflection purely of temperature increase in the skin/ear or a result of other receptor stimuli.

Burning sensations in facial skin has been discussed in connection to VDT work both in Norway and Sweden (Oftedal et al. 1995, 1997; Stenberg et al. 1993; Sandström et al. 1995). The Swedish, but not the Norwegian studies indicated an association between the time with VDT work and facial skin symptoms. A similar difference between the Norwegian and the Swedish data was found in this study. In agreement with earlier studies (Eriksson et al. 1997) we found that psychosocial work load is of importance to the prevalence of burning sensations in facial skin in both countries. However, even after having adjusted for these factors, the same positive trends were seen for both *calling time* and *number of calls* per day.

4.2 Electromagnetic field factors

The amount of microwave radiation absorbed by the user of a mobile phone is described by the so called SAR-values (Specific Absorption Rate) given in W/kg. Recently Kuster (1997) measured 16 different European digital phones, and he found a very wide variation in the SAR-values. The phone giving the lowest value, when averaged over 10 g of tissue, had an SAR of 0.28 W/kg, whilst the highest value had 1.33 W/kg; all normalised to an antenna output power of 0.25 W, which is the maximal value for a GSM phone. If the averaging was done over 1 g of tissue the span was from a lowest value of 0.42 W/kg to a highest value of 2.0 W/kg.

The output power of GSM phones is regulated by the base station, and it can be varied in 10 steps (2 dB) between the maximum peak power of 2 W down to the minimum value of 20 mW. The down regulation starts when the receiving level is above -70 dBm; when the level is above about -60 dBm, the lowest output power is used (m is taken to mean mW, i.e. 1 mW = 0 dBm). Thus, within city areas the lowest power is often used. At this level the effective output power is then 2.5 mW (duty cycle 1/8), and with the DTX battery saving

function an even lower value of about 1.5 mW would be used.

The NMT 900 phones are down regulated in one step from 1 to 0.1 W and this is effective when the input power is above -53 dBm (Hauger, E., personal communication).

When comparing the NMT 900 and GSM phones with respect to output power, it is clearly seen that the GSMs operate at a much lower level than do the NMTs. The most commonly occurring situation would presumably be that the GSM phone would operate in the low mW-region whereas the NMT 900 phone would use full output power.

The SAR measurements were done under normal user conditions. However, when the phone is slightly tilted towards the head of the user Kuster (1997) shows that the value can go from 0.2 to 3.5 W/kg. For different phones under maximal output we have a factor of about 5 between the extremes, and in addition to this, the personal handling of the phone gives a factor of tenfold or more.

The measured SAR values are restricted to localisations within the scull, while calculated SAR values often also include external structures of the head. It should be noted that given values are maximum SAR values found regardless of the anatomical localisation. An equal weighting is given to the value regardless of whether it is obtained on the external ear, middle or inner ear, or behind the ear. In the future it will be necessary to make comparisons at the same anatomical localisation. Presumably, with this taken into account, the values as given by Kuster (1997) might differ further.

Altogether there is an uncertainty concerning the actual SAR determination for a specific situation, with a factor of 100 from the nearness to the base station and at least a factor of 10-50 depending on make, model and personal usage patterns.

It is difficult to see how the actual exposure (if measured as an SAR) can be proxied by ”billing record”, a procedure that would only give the total time for outgoing calls, showing neither incoming calls in Europe, nor the power settings of the phone.

The ability for microwaves to cause a warm skin sensation have been known for decades, but only recently has this been measured under standardised laboratory conditions (Blick et al., 1997). The threshold for detection decreased monotonically with frequency and at the lowest tested frequency, 2.45 GHz, the threshold was 630 W/m^2. It can be extrapolated from the data that at 900 MHz the threshold would be in the order of 1000 W/m^2, so it is not possible to obtain any RF heating sensations from MPs with the power outputs used.

Some studies of interest to the present study indicated the potential effect of radio frequency exposure at low level. Allan Frey did research on microwave hearing in the 1960’s using intensities below 10 W/m^2. The experiments were discontinued because he himself and some of the volunteers reported headaches in connection with the experiment. This was recently reported in an overview article by Frey (1998) where he also points to the blood-brain-barrier-experiments (BBB) showing that electromagnetic energy with characteristics similar to present day cell phone emission resulted in the breakdown of the BBB. This is a critical regulatory interface which controls what gets into the brain from the blood, and it may very well be causal for headaches. Studies by Salford et al (1993) showed effects on the BBB in rats with both continuous and pulse-modulated microwave fields at 915 MHz and with SAR values well below 1 W/kg. In a follow up study, Persson, Salford and Brun (1997) reported effects on the BBB at SAR values in the mW/kg range. The effect was more pronounced with continuous radiation than it was when using pulsed fields.

Braune et al. (1998) measured an increase in the diastolic and systolic blood pressure of healthy people exposed for 35 minutes to a GSM mobile phone sending at 2W. The authors explained the effect by an increase in the sympathetic efferent activity. A reduction in capillary perfusion suggested an increased vasoconstriction.

Several studies have been published on effects on sleep in connection with exposure to low level radio frequency radiation (Altpeter et al., 1995, Reite et al., 1994, Pasche et al., 1990). Mann and Röschke (1996) studied the effect of fields from a GSM phone placed near a person during the night and they found a REM suppressive effect with reduction of duration and percentage of REM sleep. Wagner, Röschke, Mann et al (1998) could not confirm this. In the latter experiment they used a circular polarised field at lower intensity than previously (0.2 vs. 0.5 W/m^2), and the authors state that the failure to confirm the results may be due to dose-dependent effects of the fields on the human sleep profile.

Phone heating.

When using an MP for a long continuous period of time, the phone gets warm due to resistive heating of the amplifier in the phone. For some of the early models of NMT it was not possible to hold the phone in the same hand throughout a long phone call due to excess heating. This factor may then be of importance for the occurrence of warmth sensations, at least among the NMT users.

Törnevik et al. (1998) measured maximum temperature increases on some phones from 15°C to 19°C in the area of the ear piece when the phone had been operating at maximum output for 30 minutes. They also examined the temperature increase around and on the ear on volunteers holding the phone in a normal talking position. The maximum temperature readings ranged between 37°C and 41°C for analogue phones and between 36°C and 39°C for GSM phones.

If the amount of absorbed radio frequency energy or heated phones are responsible for the observed difference in the prevalence of warmth sensations between NMT and GSM users, we would also expect that longer phone calls would cause a higher prevalence of these phenomena. In fact, for warmth sensations, as well as for several of the listed nervous system symptoms, we see an increase in ORs with respect to *calling time* and *number of calls*. This does not mean that we can exclude any potential effects of modulation of the radio frequency fields or the low frequency magnetic fields from GSM phones or the effect of other factors related to MPs or the use of them.

4.3 Ergonomic factors

In addition to factors related to electromagnetic fields, factors such as audio quality, size and shape also differentiate GSM and NMT phones. In the analogue system (NMT phones), speech may be partly masked by noise, and this is most prominent when the connection with the base station is poor. On the other hand, the audio quality of the digital system might be reduced by occurrence of silent periods. When the connection with the base station is too poor, it closes completely. All these audio disturbances may cause stress and might thereby indirectly be a source of symptoms from the nervous system.

The questionnaires were distributed in 1996 and at that time NMT phones were generally older, heavier and larger in size compared to GSM phones. Therefore, using NMT phones might have been less comfortable than using GSM phones. Whether this had any implication

for the occurrence of symptoms is not known.

Specified ”other symptoms” attributed to the use of MPs were reported by 3% in the Norwegian data, while the corresponding number in Sweden is 2 %. Next to ear symptoms, pain in the neck or shoulders was most frequently reported in Norway. In Sweden, eye symptoms and skin/face symptoms were most common. Neck muscle strain as well as eye symptoms could be reasons for headaches and also possibly be associated with fatigue. This may, at least partly, explain the observed increase in the prevalence of these symptoms with respect to *calling time* and *number of calls*.

The stress factor associated with intense MP use and the concomitant microwave exposure might be of interest in view of the findings made by Dhabhar and McEwen’s (1995). They found that tube restraint of mice was followed by a 50-80% fall in blood leukocyte levels within 2 h, and then full recovery was seen in 3 h. The results suggest that acute stress induces a redistribution of leukocytes which is seen by an influx of leukocytes to the skin. They also reported delayed hypersensitivity in the skin of the ear pinna of stressed mice, measuring inflammation by increased pinna thickness and histological quantification of leukocytes. In view of the strong near-fields generated in superficial tissues of the heads of cell phone users, it may be useful to examine local tissue immune status and blood flow changes. This also points to the need for more research on microwave microdosimetry. The methods used here with averaging over 1 g or 10 g of tissue are not fully relevant for the blood vessels and nerves exposed in and behind the pinna.

4.4 Methodological bias

Selection

The selected study population, people using their MPs in their jobs, probably deviate from the total population of MP users, both with respect to variables related to the MP and the use of it, as well as with respect to other risk factors. Such differences might have caused a higher prevalence of symptoms in the study population compared to the total population. The effect of various exposure factors might not necessarily be identical for private users and job users. Thus the observed effect of transmitter system as well as of *calling time* and *number of calls*, should be restricted to the selected study population.

Because of the low number of women participating in the study, the statistical power was too low to allow a separate analysis for this group. Despite the fact that the analysis on males only does not indicate any differences from the results obtained for the whole cohort, we can not generalise the results for women. It is thought of interest to note that the prevalence of symptoms in general is higher among women than men. This is in agreement with earlier studies (Skulberg, 1998; Stenberg et al., 1993; Tibblin et al., 1990).

Response

Because of the relatively low response rates, even when adjusting for the estimated number of non-respondents who did not receive the questionnaire[1], there might have been some differences between the respondents and the total selected group. In the Swedish material, the non-respondent analysis indicated that the prevalence of symptoms attributed to MP use

[1] One reason for the high number of people that did not receive a questionnaire was a lack of updated subscription information.

was equal for non-respondents and respondents, but in the Norwegian material there was an indication of higher prevalence of symptoms attributed to MP use among the respondents than the non-respondents. There were no differences in the distribution of potential risk factors between the respondents and the non-respondents, and most important for the testing of the main hypothesis of the study, the distribution between GSM and NMT was identical. Even if the prevalence of symptoms was higher in the respondent group than in the total selected population, the analysis of the effect of various exposure factors has probably not been affected. This is also indicated by the consistency in results between the Norwegian and Swedish data.

Report/recall

Because of the media focus on possible serious health effects due to the use of MPs, users might have a tendency to over-report the occurrence of symptoms. At the time of the study, however, there had been no media focus on a potential difference in the effect of GSM and NMT phones. When comparing the prevalence of symptoms among NMT and GSM users, we would not expect any bias due to fear or concern. This would apply to both the prevalence of symptoms in general and to symptoms attributed to MP use.

Those using MPs the most, might have more concerns about the effect of the phone, and hence over-report symptoms. This would increase the tendency of an increase in the prevalence of symptoms with an increase in *calling time* or *number of calls*. On the other hand, those with concerns might tend to minimise their MP use, and thereby end up in categories with shorter *calling time* and fewer calls per days. This would diminish the observed trends for symptoms with respect to *calling time*/*number of calls*.

Even assuming that the results are biased by over-reporting of symptoms by those using MPs the most, it is not probable that this can fully explain the association found between warmth sensations and *calling time*/*number of calls*. The suggested effect is also consistent with a higher prevalence of symptoms among NMT users compared to GSM users.

For headaches and fatigue the association with *calling time* and *number of calls* is more pronounced than for any of the other nervous system symptoms. Furthermore, for these two symptoms the results are consistent irrespective of the transmitter system category (including the mixed group) and country, which is not the case for any of the other symptoms from the nervous system. This should be considered when evaluating the role of recall bias for the various symptoms.

Misclassification

A few of the respondents did not know whether they used the NMT or GSM system which could lead to a misclassification of transmitter systems. This error ought to be random.

The majority of people in the ”mixed” group used more than one MP. To estimate their total *calling time* we added the *calling times* for each MP. The same procedure was used for *number of calls*. Some people might not have used all MPs during the same period, but changed from using one MP to another. This uncertainty must be taken into consideration when interpreting the results for the ”mixed” group.

Confounding

As indicated in the histograms (Figures 1 – 5) and by the statistical significance of the ORs

obtained for individual and work related factors, most of the potential confounding factors included in the questionnaire seem to be of importance for the prevalence of symptoms. However, the confounding effect of these variables with respect to the statistical associations between exposure factors and symptoms was not pronounced. This is seen in Tables 11 – 13: the adjusted ORs for exposure factors did not deviate much from the crude ORs, and the conclusions, with respect to the effect of GSM relative to NMT, *calling time,* and *number of calls,* would have been the same based on the crude and adjusted ORs. However, there might be other confounding factors that we have not taken into consideration, for instance, lifestyle and diagnosed diseases.

Statistical uncertainties

The adjusted ORs for warmth behind/around and on the ear for GSM users with NMT users as a reference is in the range of 0.56 - 0.74. These values are statistically significant, but the upper limit of the confidence interval for three out of four values is close to 1.0, meaning that the likelihood of chance or extreme results is not much less than 5%. The consistency when comparing the Norwegian and the Swedish data, and a plausible explanation for the lower prevalence of the sensation of warmth, particularly on the ear, among GSM users compared to NMT users, makes it less likely that the results are merely due to chance.

The exposure-response relationship found between *calling time*/*number of calls* and the sensation of warmth was statistically highly significant. Furthermore, the confidence intervals, as well as the consistency between the two countries for headaches and fatigue, suggest that the likelihood of chance being the explanation for the results is low. The low number of people in the highest category of *calling time* is reflected in the relatively wide confidence intervals, and thereby increased uncertainty.

4.5 Symptoms attributed to mobile phones versus VDT and ordinary phones

More respondents attributed their symptoms to MP use than to the use of ordinary phones. When comparing MP use with VDT use, the difference is not so marked and consistent, except for the sensation of warmth on the ear or behind the ear. This analysis is not confounded by individual factors because each individual is used as his/her own control when comparing the occurrence of a symptom attributed to the various devices. The analysis might be biased by an over-reporting of symptoms related to MP use because of fear or awareness about potential health risks by the use of MPs. It is less likely, however, that the pronounced differences in symptom occurrence between MP use and use of ordinary phones can be explained by such a bias.

With the exception of the sensation of warmth behind/around or on the ear, the differences seen between symptoms attributed to MPs and VDTs are difficult to interpret. For most symptoms there was an inconsistency between the Norwegian and Swedish data. The Swedish respondents attributed more symptoms to VDTs then to MPs, while the opposite was true for the Norwegian respondents. This might reflect more media focus and concern in Sweden than in Norway about health effects caused by VDT use.

4.6 Prevalence of symptoms in Norway and Sweden

In general, there was a higher prevalence of symptoms in the Norwegian data than in the

Swedish. To some extent this may be explained by the presence of more young people and people using their MPs more in the Norwegian data compared to the Swedish. Another reason may be that the prevalence was higher among the respondents than among the non-respondents in Norway while this seems not to be the case for Sweden. Consequently, the difference in the total study population between the two countries should be less than observed in this study. Language differences may have caused some differences between the two countries. Even though efforts were made to formulate the questionnaires in the two languages so that the meaning of the questions would be identical, there may be some essential deviations.

One might also speculate about the possibility of more public concern and discussion in Norway at the time when the questionnaires were sent out and thereby the higher prevalence of reported symptoms. The follow up study in Sweden indicated that the subjects related their symptoms to MP use more frequently after a year of intensive discussion in the press, but any increase of symptoms as such was not found.

Various cultural differences as well as differences in social or economical situations might also have been reasons for the difference in the reporting of symptoms, even though the self-reported state of health was better in Norway than in Sweden.

The most pronounced differences in prevalence between Norway and Sweden were observed for the sensation of warmth behind/around and on the ear. Some older models of MPs became warmer than newer models. Since the Swedish respondents had their MPs for a longer period of time on average than the Norwegians, differences in models can be excluded as an explanation. Higher output levels which could be due to longer distances between the base stations, might explain some of the observed differences. The prevalence of the warmth sensations is somewhat lower and the density of base stations higher in the larger cities than in other places in Norway and in Northern Sweden. We do not have sufficient data to deduce if and to what extent differences in distance to base stations and other factors influencing the output level are responsible for the observed results. We should also take into account that not only the distance to the nearest base station is important for the output level. Among the factors that should be considered are the directivity of the base station, calls being routed to more distant stations, and the interference of buildings, hills or mountains. Some of these factors might also vary between the two countries.

4.7 Methodological aspects - future studies

The exposure assessment of methodological aspects will be a challenge in future studies. First of all, it should be registered whether MPs are used with an active antenna close to the head by asking about the use of hands-free equipment and car mounted antennas. The inconsistency in response to the questions concerning these facilities in this study suggests that it is important to explain carefully what is meant by these devices. For users of car mounted antennas, it should also be clarified whether the MP is used with hands-free equipment or not. This would be important for evaluating the role of direct contact with the heated MP.

We have pointed to the variation in anatomical location where the maximal values have been measured. When considering the microwave dosimetry, the mechanisms underlying the symptoms experienced should also be taken into account.

The questionnaire contained three variables of interest for the estimation of MP exposure:

Transmitter system, *calling time* and *number of calls* per day. To estimate exposure in terms of RF and/or ELF fields, measurements as well as information about design and individual handling of the MP (as discussed earlier) are needed. However, this might be further explored and roughly estimated in later analyses, including different MPs with different antenna designs.

To assess the exposure time, self-reporting as selected in this study might be a useful approach. In addition to the questions about the total *calling time* per day and *number of calls* per day, it could also be relevant to register directly the average duration of the calls. If fixed categories are to be used, the distribution of the study population between the various categories should be assessed so that there would be less variation of the number of people within each category than was the case in this study. It could also be interesting if the upper category of *number of calls* is split up in two categories, making it possible to study those who use their MP more frequently than 8 times a day.

4.8 Summary of factors that might explain observed results

We have indicated that a number of potential risk factors related to MPs or the use of them might explain the observed differences in prevalence between GSM users and NMT users, as well as the increase in prevalence with increasing *calling time* and *number of calls*. Among the various potential methodological reasons for the observed results, bias might, to a certain extent have been responsible for the correlation between symptom occurrence and *calling time/number of calls*. Furthermore, there might be confounding factors that have not been identified and taken into account. We observe that the effect of *calling time* and *number of calls* is more marked for the warmth sensations than for the various nervous system symptoms. Furthermore, there is a good correlation between the occurrence of the warmth sensations and both headaches and fatigue, suggesting that these symptoms are caused by the sensation of warmth. The same results would also occur if those two groups of symptoms have a common cause, but with the most pronounced effect on the sensation of warmth. Alternatively, different but correlated factors might be responsible for the various symptoms. Based on the results of this study, variables related to the electromagnetic fields (radio frequency and for GSM phones low frequency magnetic fields), heated MPs as well as factors related to possible hearing difficulties may explain why the prevalence of warmth sensations, headaches, fatigue and symptoms from the nervous system increase with increasing *calling time* and *number of calls*.

As for the heating sensation behind/around and on the ear, we can not say from this study whether the burning sensations in facial skin is a result of a general warming effect due to the pressure of the MP, heating due to the battery package, RF exposure, or if this is a phenomenon caused by the nervous system reaction or if vascular components may be involved.

5. Conclusions

The hypothesis originally postulated, that GSM users have a higher prevalence of symptoms than NMT users, was falsified by the study. In fact, GSM users reported warmth sensations behind/around or on the ear less frequently than did NMT users. Based on these results we can not deduce the role of radio frequency emission, temperature of the phones and other physical differences between GSM phones and NMT phones.

Demonstrable statistical associations between *calling time* and *number of calls* per day and the occurrence of warmth sensations, as well as headaches and fatigue were found among both NMT users and GSM users in both countries. Whether this association also demonstrates a causal relationship between MP use and the genesis of the different symptoms can not be determined. The findings, however, give rise to the hypothesis that *calling time* and *number of calls* are associated with a sensation of warmth and some nervous system symptoms. Further studies are required to test this hypothesis and to explore the role of the various physical factors.

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Appendix A

Definition of symptoms, factors, and categories of factors.

Symptoms, possible confounding factors and exposure factors, and the categories of these factors are defined in tables AA.1, AA.2, and AA.3 respectively.

Table AA.1. Description and short names of symptoms.

Symptom description	Short name
Dizziness	Dizziness
General discomfort	Discomfort
Difficulties concentrating	Concentration
Memory loss	Memory loss
Abnormal drowsiness/fatigue	Fatigue
Headaches	Headaches
Sensation of warmth behind/around the ear	Warmth behind ear
Sensation of warmth on the ear	Warmth on ear
Burning sensations in the facial skin	Burning skin
Tingling/tightness sensation in the facial skin	Tingling/tightness
Other symptoms	Other

Table AA.2. Description and short names of possible confounding factors and exposure factors.

Description of factors	Short name of factors
Gender	Gender
Age	Age
Geographical location of work place	Geography
Occupation categories	Occupation
Psychosocial index	Psychosocial index
Work time with VDT	VDT work
Transmitter system	Transmitter system
Using the mobile phone with hands-free equipment and/or external vehicle mounted antenna	Hands-free/external antenna
Period of time with mobile phone	Time with MP
Number of calls per day	Number of calls
Length of calling time per day	Calling time

Table AA.3. Description and short names of categories of possible confounding factors and exposure factors. The categories printed in bold are defined as reference categories for the statistical analysis.

Factor	Description of categories	Short name of categories
Gender	**Male**	**Male**
	Female	Female
Age	< 30 years	< 30 yrs
	30 - 39 years	30 - 39 yrs
	40 - 49 years	40 - 49 yrs
	³ **50 years**	³ **50 yrs**
Geography	**Larger cities**	**Larger cities**
	Smaller cities and rural areas in Southern Sweden/Norway[1)]	Southern Sweden/Other places
	Smaller cities and rural areas in Northern Sweden	Northern Sweden
Occupation	**Management**	**Management**
	Professional	Professional
	Intermediate non-manual employees	Intermediate
	Other	Other
Psychosocial index	**High**	**High**
	Medium	Medium
	Low	Low
VDT work	No VDT work	No
	< 1 hours/day	**< 1 hr/d**
	1 – 4 hours/day	1 – 4 hrs/d
	> 4 hours/day	> 4 hrs/d
Transmitter system	**NMT 900 users with one mobile phone only**	**NMT 900**
	GSM users with one mobile phone only	GSM
	Categories and combination of categories other than those defined above. Missing also included.	Mixed
Hands-free/ external antenna[2)]	Always uses the MP with hands-free/external antenna	Always
	Sometimes uses the MP with hands-free/external antenna	Sometimes
	Never uses the MP with hands-free/external antenna	Never
Time with MP	**< 13 months**	**< 13 mths**
	13 – 24 months	13 – 24 mths
	> 24 months	> 24 mths
Number of calls	**< 2 calls/day**	**< 2 calls/d**
	2 - 4 calls/day	2 - 4 calls/d
	> 4 calls/day	> 4 calls/d
Calling time	**< 2 mins/day**	**< 2 mins/d**
	2 - 15 mins/day	2 - 15 mins/d
	15 - 60 mins/day	15 - 60 mins/d
	> 60 mins/day	> 60 mins/d

1). Only the southern part of Norway is included in the study.

2). This factor is not included in the statistical analysis and therefore no reference category is defined.

Appendix B

Distribution of transmitter systems

The distribution of respondents between all transmitter systems and all combinations of transmitter systems is shown in Table AB 1. In this table GSM and NMT 900 include people with either one or more than one MP.

Table AB.1. Number of respondents using the various transmitter systems. A: Norway, B: Sweden.

A: Norway

	Transmitter system								Total
	NMT 900	GSM	NMT 450	NMT 900 & GSM	NMT 900 & NMT 450	GSM & NMT 450	NMT 900, GSM & NMT 450	Missing	
Count	930	1149	56	462	66	94	25	46	2828
Percent	33%	41%	2.0%	16%	2.3%	3.3%	0.9%	1.6%	100%

A: Sweden

	Transmitter system								Total
	NMT 900	GSM	NMT 450	NMT 900 & GSM	NMT 900 & NMT 450	GSM & NMT 450	NMT 900, GSM & NMT 450	Missing	
Count	2265	3073	286	980	578	254	148	219	7803
Percent	29%	39%	3.7%	13%	7.4%	3.3%	1.9%	2.8%	100%

Appendix C

State of health

The state of health of people using different transmitter systems is shown in table AC.1.

Table AC.1. Distribution of respondents for the categories of transmitter system and for the total group of respondents with respect to state of health A: Norway, B: Sweden.

A: Norway

Factor	Category	Transmitter system						Total	
		NMT 900		GSM		Mixed			
		Count	Percent	Count	Percent	Count	Percent	Count	Percent
State of health	Good	718	82	847	85	790	83	2355	83
	Average	136	16	137	14	141	15	414	15
	Not so good	6	0.7	9	0.9	11	1.2	26	0.9
	Missing	13	1.5	8	0.8	12	1.3	33	1.2

B: Sweden

Factor	Category	Transmitter system						Total	
		NMT 900		GSM		Mixed			
		Count	Percent	Count	Percent	Count	Percent	Count	Percent
State of health	Good	1318	69	1943	74	2308	71	5569	71
	Average	502	26	584	22	800	25	1886	24
	Not so good	42	2	34	1	44	1	120	2
	Missing	53	3	73	3	102	3	228	3

Appendix D

Non-respondent analysis

AD.1 Methods

The non-respondent analysis investigated why subjects did not respond to the questionnaire, and compared symptoms between the non-respondents and respondents. Because of the relatively low response rate in Norway, their potential risk factors were compared between non-respondents and respondents.

About 10% of the non-respondents were selected randomly for analysis, 50% among GSM subscribers and 50% among NMT subscribers; in total 555 subjects (200 in Norway and 355 in Sweden).

The subjects were enlisted by phone, using the MP number by which they were identified for the study. If this did not work we called the company responsible for the subscription bill. If a person was not available or unknown to the company, his/her private phone number was traced.

The interview was performed using a questionnaire. We asked whether the person had experienced any health complaints in connection with the use of an MP. In Norway, the subjects were asked whether they had experienced heat sensations if they had said that they had not experienced any symptoms. (Most people do not consider heat sensations a health complaint or symptom.)

The following information was available from the subscription data base for the Norwegian data: information about gender (derived from first name); geographical location of work place (each of the larger cities compared to smaller places, information derived from area post code); trade (a surrogate for occupation, information derived from the NACE-codes (the European Standard for trade classification)); transmitter system.

AD.2 Results

Among the individuals in the non-respondent analysis, 91% and 60% respectively for Norway and Sweden, were interviewed and answered all the questions, and 3.5% and 5% respectively, only gave the reason why they had not responded and were not willing to give further information about the transmitter system used or symptoms. See table AD.1.

Table AD.1. Number of people participating in the non-respondent analysis that were interviewed or were not reached for interview.

	Norway		Sweden	
	Count	Percent	Count	Percent
Interviewed:				
Willing to give information	182	91%	238	60%
Unwilling to give information[1]	7	3.5%	21	5%
Not reached	11	5.5%	141	35%
Total	200	100%	400	100%

1. No information about transmitter system and symptoms.

Among the non-respondents, the number of people who did not receive a questionnaire was relatively high: 21% in Norway, 43% in Sweden. The most common reason for no response, however, was low priority (reasons like: not interested, no time available, forgotten to post the questionnaire): 71% in Norway and 44% in Sweden. Only two individuals in Sweden and one in Norway replied that he/she did not answer because of personal integrity. See table AD.2.

Table AD.2. Reasons why people selected for the non-respondent analysis did not respond to the questionnaire. A. Norway, B. Sweden.

A: Norway

Reason for no response to the questionnaire	Transmitter system						Total	
	NMT 900		GSM		Mixed			
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Not received any questionnaire:	**16**	**22**	**14**	**15**	**12**	**38**	**42**	**21**
Q. not forwarded by former employer[1)]	3	4.1	3	3.2	5	16	11	5.5
Not known in the company[1)]	0	0.0	0	0.0	2	6.3	2	1.0
Company did not exist[2)]	0	0.0	0	0.0	1	3.1	1	0.5
Other reasons for not received the q.	13	18	11	12	4	13	28	14
Low priority:	**54**	**73**	**74**	**79**	**14**	**44**	**142**	**71**
Not interested	18	24	20	21	6	19	44	22
No time available	30	41	50	53	6	19	86	43
Forgotten to post the questionnaire	6	8.1	4	4.3	1	3.1	11	5.5
Lost the questionnaire	0	0.0	0	0.0	1	3.1	1	0.5
Other reasons	**4**	**5.4**	**3**	**3.2**	**0**	**0.0**	**7**	**3.5**
Personal integrity	0	0.0	1	1.1	0	0.0	1	0.5
Could not because of illness	2	2.7	0	0.0	0	0.0	2	1.0
Had not used MP recently	2	2.7	2	2.1	0	0.0	4	2.0
Missing information	0	0.0	3	3.2	6	19	9	4.5
All reasons for no response	**74**	**100**	**94**	**100**	**32**	**100**	**200**	**100**

B: Sweden

Reason for no response to the questionnaire	Transmitter system						Total	
	NMT 900		GSM		Mixed			
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Not received any questionnaire:	**26**	**26**	**14**	**24**	**111**	**56**	**151**	**43**
Q. not forwarded by former employer[1)]	0	0.0	0	0.0	2	1.0	2	0.6
Not known in the company[1)]	0	0.0	0	0.0	27	14	27	7.6
Company did not exist[2)]	0	0.0	0	0.0	66	34	66	19
Other reasons for not received the q.	26	26	14	24	16	8.1	56	16
Low priority:	**61**	**62**	**37**	**63**	**57**	**29**	**155**	**44**
Not interested	10	10	12	20	16	8.1	38	11
No time available	35	35	17	29	30	15	82	23
Forgotten to post the questionnaire	9	9.1	5	8.5	5	2.5	19	5.4
Has returned the questionnaire	7	7.1	3	5.1	6	3.0	16	4.5
Other reasons:	**12**	**12**	**8**	**14**	**29**	**15**	**49**	**14**
Personal integrity	0	0.0	0	0.0	2	1.0	2	0.6
Could not because of illness	0	0.0	0	0.0	1	0.5	1	0.3
Had not used MP recently	1	1.0	3	5.1	12	6.1	16	4.5
Difficult questionnaire	2	2.0	2	3.4	0	0.0	4	1.1
Other reasons	6	6.1	3	5.1	10	5.1	19	5.4
Missing information	3	3.0	0	0.0	4	2.0	7	2.0
All reasons for no response	**99**	**100**	**59**	**100**	**197**	**100**	**355**	**100**

1): The company which, according to the subscription information, was responsible for the subscription bill was contacted, and in some cases the person was interviewed.
2): The company which, according to the subscription information, was responsible for the subscription bill, was untraceable.

People who did not respond because they had not received the questionnaire were probably more similar to the respondents than people who did not respond because of other reasons, such as lack of interest. The difference in symptoms between those who did not receive the questionnaire and other non-respondents is interesting and might indicate possible differences between respondents and non-respondents. The relative number of subjects that had experienced symptoms in connection with MP use is given in Table AD.3 for those two groups of non-respondents.

Table AD.3. The relative number of non-respondents that had experienced symptoms in connection with MP calls and the total number of people for the various groups of non-respondents.

	Norway		Sweden	
	Not received questionnaire	Other reasons	Not received questionnaire	Other reasons
Percentage with symptom	14 %	16%	14%	13%
Total number within group	N=35	N=142	N=49	N=155

In both countries the relative number of people with symptoms was almost equal for those who did not receive a questionnaire and for those who did not respond because of other reasons.

When comparing the relative number of respondents and non-respondents that had experienced symptoms in connection with MP calls, it should be emphasised that the symptom information was collected in different ways. The non-respondents were asked whether they experienced any symptom in connection with MP calls, whereas those who filled in the questionnaire were presented with a list of different symptoms. (The relative number of respondents that had experienced various symptoms in connection with MP calls is given in section 3.4) To compare the occurrence of symptoms between respondents and non-respondents, a respondent is defined as having an MP related symptom if he/she marked at least one of the listed symptoms in connection with MP calls.

In Sweden 13% of the respondents and 15% of the non-respondents had experienced at least one symptom in connection with MP calls. In Norway the corresponding figures for any symptom were 30% of the respondents and 17% of the non-respondents. Furthermore, the Norwegian data revealed that 26% of the respondents and 12% of the non-respondents had experienced sensations of warmth on or behind the ear, and 22% of the respondents and 6% of the non-respondents had experienced MP related symptoms other than sensations of warmth on or behind the ear.

The subscription information for all the people selected for the Norwegian part of the study was analysed with respect to possible risk factors. No differences between respondents and non-respondents were revealed for any of the risk factors for which information was available. See table AD.4.

Table AD.4. Distribution of possible risk factors for respondents and non-respondents in the Norwegian data.

Factor	Categories	Response				Total	
		Respondents		Non-respondents			
		Count	Percent	Count	Percent	Count	Percent
Transmitter system	NMT 900	1420	50	1080	50	2500	50
	GSM	1408	50	1092	50	2500	50
	Missing	0	0.0	0	0.0	0	0.0
Gender	Male	2553	90	1973	91	4526	91
	Female	275	9.7	170	7.8	445	8.9
	Missing	0	0.0	29	1.3	29	0.6
Geography	Oslo	1553	55	1243	57	2796	56
	Bergen	182	6.4	148	6.8	330	6.6
	Trondheim	85	3.0	63	2.9	148	3.0
	Stavanger	40	1.4	33	1.5	73	1.5
	Kristiansand	28	1.0	20	0.9	48	1.0
	Smaller places	940	33	665	31	1605	32
	Missing	0	0.0	0	0.0	0	0.0
Trade	Agriculture and fishing	4	0.1	9	0.4	13	0.3
	Mining and construction	212	7.5	172	7.9	384	7.7
	Industry and energy supply	421	15	248	11	669	13
	Commerce	776	27	644	30	1420	28
	Hotels and restaurants	11	0.4	11	0.5	22	0.4
	Transportation and communication	80	2.8	68	3.1	148	3.0
	Financial and business services	391	14	301	14	692	14
	Public administration, organisations	69	2.4	30	1.4	99	2.0
	Health and social care	9	0.3	7	0.3	16	0.3
	Missing	855	30	682	31	1537	31

Appendix E

Factors included in multivariate logistic regression models

*Table AE.1. Factors included in the logistic regression models for analysis of the variable transmitter system (table 11). Inclusion was made by forward stepwise selection (Wald statistics) for Norway (**x**) and Sweden (**o**).*

Symptoms	Gender	Age	Geography	Occupation	Psychosocial index	VDT-work	*Calling time* mins/d	*Number of calls*/d
Dizziness	- o	x -	- o	- o	x o	- -	x -	- -
Discomfort	- -	x o	x -	x -	x o	- -	x o	- -
Concentration	- -	- -	- -	- o	x o	- o	x o	- -
Memory loss	- -	- o	- -	- -	x o	- -	x o	- o
Fatigue	x o	x o	- -	- -	x o	- -	x o	x o
Headaches	x o	x o	x o	- -	x o	- -	x o	x -
Warmth behind ear	- o	x o	- o	x o	- o	- -	x o	x o
Warmth on ear	- o	x o	- -	x -	- o	- o	x o	x o
Burning skin	x o	x o	- o	- -	x o	- o	x o	- -
Tingling/tightness	- o	- -	- -	- -	- o	- o	x o	- -
Mixed	- -	x -	- -	- -	x o	- o	x o	- -

*Table AE.2. Factors included in the logistic regression models for analysis of the combination variable "transmitter system – calling time per day"(table 12). Inclusion was made by forward stepwise selection (Wald statistics) for Norway (**x**) and Sweden (**o**).*

Symptoms	Gender	Age	Geography	Occupation	Psychosocial index	VDT-work
Dizziness	- o	x -	- o	- o	x o	- -
Discomfort	- -	x o	x -	- -	x o	- -
Concentration	- -	- -	- -	x o	x o	- o
Memory loss	- -	- o	- -	- -	x o	- -
Fatigue	- o	x o	- -	- o	x o	- -
Headaches	- o	x o	x -	- -	x o	- -
Warmth behind ear	- -	x o	- o	x o	- o	- -
Warmth on ear	- o	x o	- -	x -	- o	- o
Burning skin	x o	x o	- o	- -	x o	- o
Tingling/tightness	- o	- -	- -	- -	- o	- o
Mixed	- -	x -	- -	- -	x o	- o

*Table AE.3. Factors included in the logistic regression models for analysis of the combination variable "transmitter system – number of calls/day"(table 13). Inclusion was made by forward stepwise selection (Wald statistics) for Norway (**x**) and Sweden (**o**).*

Symptoms	Gender	Age	Geography	Occupation	Psychosocial index	VDT-work
Dizziness	- o	x -	- o	- o	x o	- -
Discomfort	- -	x o	- -	- -	x o	- -
Concentration	- -	x -	- -	- o	x o	- o
Memory loss	- -	- o	- -	- -	x o	- -
Fatigue	x o	x o	- -	- -	x o	- -
Headaches	x o	x o	x -	- -	x o	- -
Warmth behind ear	- o	x o	- o	x o	- o	- -
Warmth on ear	- o	x o	- -	x -	- o	- o
Burning skin	x o	x o	- o	- -	x o	- o
Tingling/tightness	- -	- -	- -	- -	- o	- o
Mixed	- -	- -	- -	x -	x o	- o

Appendix F

Additional mailings

Two additional mailings have been done in Sweden to find out the reliability of the individual answers and also to see how the prevalence of symptoms, as well as the total work situation, change over time. The mailings were sent after one year and again one month after that. 30 people were randomly selected to participate. They were contacted by phone to find out if they were available during the period. It was of particular interest to find any changes in symptoms experienced during the recall period. As the recall period was a year, none or very few changes in the score of experienced symptoms should be noted in the questionnaires with one month difference in recall time.

Four people increased their *number of calls* per day after one year, while 3 people made corresponding decreases. Corresponding numbers in the responses one month later were 1 and 2 respectively.

Three people increased their *calling time* similar to one category after one year while 10 people made corresponding decreases. Of the responses one month later there were 4 with increased and 4 with reduced *calling times* corresponding to one category.

Eight people changed their psychosocial category a year later. Two people increased psychosocial work load from ”medium” to ”high”, while 6 people decreased their index from ”high” to ”medium”. Six people reported changes one month on. One person decreased his/her index from ”medium” to ”low”, 2 people from ”high” to ”medium”, and 3 people increased psychosocial work load from ”medium” to ”high”.

There were no changes in the mean score for all symptoms in the group for the different time periods, but, looking at the individual answers, some of the subjects changed category. In total 11 people changed categories for one or more symptoms when the recall period was one year later, while changes in symptom categories after one additional month were seen in 8 people. See Tables A.1 and AF.2.

Only one person reported a symptom (”heat on the ear”) related to MP use in the first mailing, while 5 people reported ”heat on and behind the ear” one year later. A comparison of the answers after one additional month showed an increase in the number of reported symptoms related to MP use. The number of people with warmth sensations related to MP use increased from 5 to 7, and 2 people then reported nervous system symptoms related to MP use. See Table AF.3.

Table AF.1. Number of people with changes in their symptoms score. Increase (+) and decrease (-) for each symptom, as well as the number of people who changed category during one year due to the deviation.

	No. with deviation			No. with changes in category
Symptoms	+/-1	+/-2	+/-3	+/-
Dizziness	1/0	0/0	0/0	-
Discomfort	2/0	1/0	0/1	1/1
Concentration	5/0	1/2	0/1	3/3
Memory loss	5/0	0/1	0/0	2/1
Fatigue	5/2	2/2	0/0	4/2
Headaches	4/1	0/0	0/0	1/-
Warmth behind ear	3/2	3/1	0/0	3/1
Warmth on ear	3/1	1/1	0/0	1/1
Burning skin	0/1	0/1	0/0	-/1
Tingling/tightness	0/2	0/1	0/0	-
Other	0/0	0/1	0/0	-

Table AF.2. Number of people with changes in their symptoms score. Increase (+) and decrease (-) for each symptom as well as the number of people who changed category during one month due to the deviation.

	No. with deviation			No. with changes in category
Symptoms	+/-1	+/-2	+/-3	+/-
Dizziness	0/3	0/0	0/0	-
Discomfort	0/3	0/0	0/0	-
Concentration	2/4	0/0	0/0	1/1
Memory loss	1/5	0/0	0/0	-/2
Fatigue	1/3	0/0	0/0	2/3
Headaches	1/6	0/0	0/0	-/1
Warmth behind ear	3/1	-/2	0/0	2/2
Warmth on ear	3/1	0/0	0/0	2/-
Burning skin	0/0	0/0	0/0	-
Tingling/tightness	0/2	0/1	0/0	-
Other	2/0	0/0	0/0	1/-

Table AF.3. Number of people in each mailing out who reported that noted symptom was related to MP use. 1st mailing in November 1996, 2nd in November 1997 and the last one month later.

	No. of people		
Symptoms	1st mailing	2nd mailing	3rd mailing
Dizziness	-	-	-
Discomfort	-	-	1
Concentration	-	-	2
Memory loss	-	-	-
Fatigue	-	-	2
Headaches	-	-	-
Warmth behind ear	-	2	5
Warmth on ear	1	5	7
Burning skin	-	-	-
Tingling/tightness	-	-	-
Other	-	-	-

Appendix G

Questionnaires

Please contact the authors for a copy of the questionnaire.