
**Health complaints related to low-dose environmental
exposures: Analysis and evaluation of an
interdisciplinary environmental medicine pilot project
in the Basel area**

Inauguraldissertation

**zur Erlangung der Würde einer Doktorin der Philosophie
vorgelegt der
Philosophisch-Naturwissenschaftlichen Fakultät
der Universität Basel
von**

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Basel, 2005**

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Zusammenfassung

HINTERGRUND: Schädliche Einflüsse der Umwelt auf die Gesundheit des Menschen sind in den letzten Jahrzehnten sowohl für die Wissenschaft als auch für die Öffentlichkeit stärker in den Mittelpunkt des Interesses gerückt. Viele Menschen führen ihre Beschwerden auf Umweltexpositionen zurück. Nach Einschätzung einiger Selbsthilfegruppen sind allein in der Schweiz Tausende von Personen von multipler Chemikalien-Unverträglichkeit und elektromagnetischer Hypersensibilität betroffen. Ihre genaue Anzahl ist aber nicht bekannt. Ebenfalls unbekannt ist, wie viele Personen wegen dieser Gesundheitsprobleme medizinischen und/ oder umweltfachlichen Rat suchen. Dementsprechend könnte diese Personengruppe einen wichtigen Faktor für die Inanspruchnahme des Gesundheitssystems darstellen.

Im Allgemeinen wenden sich Betroffene entweder an ihren Hausarzt oder an Umweltämter, wie z.B. Umweltfachstellen für chemische Sicherheit oder Lufthygiene. Sowohl Ärzte als auch Mitarbeiter von Umweltfachstellen verfügen nur über ein begrenztes Wissen des jeweiligen anderen Fachgebietes und stossen daher bei der Beratung schnell an ihre fachlichen Grenzen. Hinzu kommt, dass psychologische Faktoren zur Entstehung und Aufrechterhaltung von unspezifischen Gesundheitsbeschwerden beitragen können.

ZIEL: Die vorliegende Arbeit untersucht den Bedarf, die Durchführbarkeit und Wirksamkeit umweltmedizinischer Beratung in der Schweiz. Die Konsequenzen der Forschungsergebnisse für das schweizerische Gesundheitssystem werden diskutiert.

METHODEN: Unter Mitwirkung von 250 Ärzten, die am "Schweizer Sentinella-Meldesystem" teilnehmen, wurden umweltmedizinische Beratungen in der Allgemeinpraxis erfasst. Die Ärzte wurden beauftragt, während des Jahres 2002 Patienten mit umweltmedizinischen Problemen zu dokumentieren.

Weiterhin wurde während des Jahres 2001 in der Region Basel eine interdisziplinäre umweltmedizinische Beratung angeboten, bei der sich Personen beraten lassen konnten, die ihre

Gesundheitsprobleme auf Umweltbelastungen zurückführten. In diesem Pilotprojekt wurden 63 Teilnehmer sowohl medizinisch als auch psychologisch-psychiatrisch untersucht, und erhielten einen Hausbesuch von einer Umweltfachperson. Bei 25 Teilnehmern, die ihre Beschwerden spezifisch auf elektromagnetische Felder (EMF) zurückführten, wurden zusätzlich entsprechende Messungen durchgeführt.

Die Ergebnisse dieser Untersuchungen wurden in gemeinsamen Fallkonferenzen diskutiert. Anschliessend erfolgte die Beratung des jeweiligen Teilnehmers. Ungefähr ein halbes Jahr nach der Beratung wurde das Projekt mit Hilfe von Telefoninterviews evaluiert.

ERGEBNISSE: Konsultationen aufgrund von Umweltbelastungen in den schweizerischen Allgemeinpraxen waren selten und machten 0,03 % aller Konsultationen aus.

Die Mehrheit der Teilnehmer des umweltmedizinischen Pilotprojekts hatte vor der Projektteilnahme bereits bei verschiedenen Gesundheitseinrichtungen Hilfe gesucht. Sie hatten mehr Auslagen für die Gesundheit, die nicht durch die Krankenkasse gedeckt waren, als Personen einer repräsentativen (symptomatischen) Bevölkerungsstichprobe. Die Probleme der Ratsuchenden waren komplex: Häufig bestanden psychische Belastungen, aber bei 40% der Teilnehmer war die Theorie einer Umweltverursachung mindestens eines der genannten Gesundheitsprobleme plausibel. Generell schloss eine psychiatrische Diagnose Symptome aufgrund von Umweltbelastungen nicht aus, dasselbe galt in umgekehrter Richtung.

Die Evaluation der EMF-Fälle ergab, dass wenige Personen eine besondere EMF-Empfindlichkeit hatten. Die gesetzlichen Grenzwerte wurden in keinem der Haushalte überschritten.

Bei der Evaluation des Projektes gab ein gutes Drittel der Teilnehmer an, von dem Projekt profitiert zu haben und berichtete über eine Verbesserung der bereits seit langem bestehenden Gesundheitsprobleme.

SCHLUSSFOLGERUNGEN: Die Resultate dieses umweltmedizinischen Projektes lassen diese Schlussfolgerungen zu: Personen, die Gesundheitsbeschwerden auf Umweltbelastungen

zurückführen, können nur von einem interdisziplinären Team adäquat beraten werden. An der Abklärung beteiligt sein sollten Vertreter aus dem medizinischen, psychologisch-psychiatrischen und umweltfachlichen Bereich. Auf die Gesamtbevölkerung bezogen scheinen nur wenige betroffen zu sein. Diese Personen benötigen jedoch eine Unterstützung, welche die existierenden Strukturen nicht gewährleisten können. Die Einführung eines umweltmedizinischen Beratungsdienstes in der Schweiz wird gegenwärtig diskutiert (April 2004).

Abstract

BACKGROUND: Over the last decades, adverse effects of the environment on human health have become a major concern both for the scientific community and the general public. Many people suspect that environmental exposures cause their health problems. According to some self-help groups, there are thousands of individuals in Switzerland who are affected by multiple chemical sensitivities or electromagnetic hypersensitivity. The number of people who believe that they are affected, and who will eventually seek medical help and/ or environmental counselling, could thus be an important factor in the availment of health care.

Concerned persons generally either consult their general practitioner or environmental protection agencies responsible for chemical safety or air hygiene. However, both physicians and the environmental agencies are hindered by inadequate knowledge of each other's area of specialisation. Furthermore, it is well known that psychological factors can contribute to the development or maintenance of unspecific health complaints.

AIM: To assess the need, the feasibility and the efficacy of environmental medicine counselling in Switzerland. To discuss the implications of the research results for the Swiss health care system.

METHODS: Environmental medicine consultations in general practice were assessed with the help of nearly 250 physicians who participate in the "Swiss Sentinel Surveillance Network". In 2002, the physicians were asked to record the number of patients who reported health problems attributed to environmental exposures.

During 2001, persons who attributed their health problems to environmental exposures were counselled in an interdisciplinary environmental medicine pilot project. Sixty-three participants, living in the Basel area, had a medical and a psychological-psychiatric examination and were visited at home by an environmental hygienist. Electromagnetic field (EMF) measurements were conducted at the homes of 25 participants who attributed their

health complaints specifically to EMF. The results of all the investigations were discussed in joint case conferences, and were followed by counselling of the participants. The project was evaluated approximately half a year after participation, using telephone interviews.

RESULTS: Environmental-exposure related consultations in general practice in Switzerland were rare; comprising 0.03 % of all consultations.

The majority of participants in the environmental medicine project had sought help from a wide range of health care providers before enrolling in the study. Participants had also spent more money on health care not covered by health insurance than a representative (symptomatic) sample of the population. Presented problems were complex: The proportion of participants with psychological-psychiatric problems proved to be high; however 40 % of participants had a plausible theory for the environmental aetiology of at least one of their health problems. Overall, psychiatric diagnoses did not exclude environmentally caused symptoms and vice versa.

The evaluation of the EMF-cases indicated that few persons were particularly susceptible to EMF. Legal threshold values for EMF were not exceeded in any of the homes.

More than a third of the participants reported that they benefited from the project and their long lasting health problems improved following participation.

CONCLUSIONS: The results of the environmental medicine project strongly suggest that only an interdisciplinary structure including medical, psychologic-psychiatric and environmental expertise is likely to be able to adequately diagnose environmental related health problems and provide suitable advice to persons who attribute health complaints to environmental exposures. Although the proportion of the population affected is low, those affected cannot obtain adequate advice from existing health care structures. The implementation of an environmental medicine counselling service in the Basel area is currently under discussion (April 2004).

Acknowledgements

This study was financed by the foundation 'Mensch – Gesellschaft – Umwelt', University of Basel (No. F3/00), the BAG – Swiss Federal Office of Public Health, Bern -, BUWAL – Swiss Agency for the Environment, Forests and Landscape – and the foundation AHA! – Asthma Haut Allergie, Berne, and the research fund of the University Hospital Basel. This thesis was carried out at the Institute for Social and Preventive Medicine in Basel, Switzerland. A stipend from the FAG (Freiwillige Akademische Gesellschaft) supplied funds for finalising this PhD work.

This thesis, carried out in a challenging interdisciplinary field, involved many persons who contributed in different ways to this work.

First of all, I wish to thank my supervisor Prof. Dr. Charlotte Braun-Fahrländer. Charlotte, I am deeply grateful for your encouragement, support both in professional and personal questions and challenge as a partner for many fruitful discussions. Your trustfulness that a geographer could also navigate into the field of epidemiology made me find my way. Thank you very much!

I would also like to thank the members of our project team for ideas, discussion, help with specific investigations and overall support. Thanks go to: Prof. Dr. Joachim Küchenhoff and Pia Heller (Psychiatric University Hospital Basel), Prof. Dr. Andreas Bircher and Dr. Simone Schwarzenbach (University Hospital Basel), Roger Waeber (Federal Office of Public Health), Dr. Markus Niederer (State Laboratory Basel-City), Dr. Josef Tresp, Lukas Wegmann and Heinz Kuster (Amt für Umwelt und Energie, Liestal) and Kari Fischer from Lucerne.

I am grateful to Prof. Dr. Marcel Tanner from the Swiss Tropical Institute for attending this thesis as representative of the faculty and Dr. Dieter Eis from the Robert Koch Institute in Berlin for his support as co-referent. Thanks go also to Prof. Dr. Ursula Ackermann-Liebrich

Acknowledgements

that I could work at the ISPM. Dr. Christian Schindler and Dr. Leticia Grize are thanked for their patience and helpfulness to answer all those significant questions.

Thanks go to my colleagues who make working at the ISPM a pleasure and contribute to the exceptional positive atmosphere: Dr. Sara Downs, Dr. Kerstin Hug, Dr. Sonja Kahlmeier, Reinhold Merkle, Dr. Lucy Oglesby, Dr. Martin Rösli, Marco Waser, thanks for your feedback, discussions and debates about the all the important details at work and at home. Marco and Reinhold, who would have thought that building a team at the institute would qualify us for taking part the world championships? Sonja and Sara and Sven, thank you very much for proofreading and input!

Very special thanks go to Hektor und Helga for showing us all the nice and pleasurable sides of Bern and surroundings – you made us feel welcome and at home in Switzerland. I have now understood that mountains are actually not in the way when I need a look at the horizon (although I still find that it takes a lot of sweat to get to that point). I want to thank my parents and the three stars of the north for personal support and encouragement. Gesche, Kirsten and Tina, I am still surprised and thankful for that wind of fate that seems to blow us all to the shores of the north sea.

Last but not least, thanks and all my love to Sven. Gatherer of titles and diplomas, you seem to drag me to places where I don't want to go, resulting in the broadening of my horizon and the invaluable enlargement of our circle of friends.

Acknowledgements

1 Introduction and Background

1.1 Environmental medicine: open issues

The diversity of indoor environmental exposures has increased in past decades. In addition, the improved sealing of the buildings in order to minimise energy loss can lead to an accumulation of indoor pollutants (Waeber et al. 1997). At the same time, adverse effects of the environment on human health have become a major concern of the scientific community and the general public. Though adverse health effects may be caused by many environmental, and occupational exposures (see e.g. WHO air quality guidelines or SUVA: Grenzwerte am Arbeitsplatz), significant gaps in our knowledge remain with respect to health effects from low dose environmental exposures encountered in everyday life (see e.g. Fairhurst 2003; Feron et al. 2002; Calabrese 2002).

The widespread use of mobile (cellular) phones worldwide in recent years has led to an increased interest in potential health risks of high frequency electromagnetic fields (EMF). Although there is a vast body of material on the possible biological effects from these fields, risk assessment is still limited (Ahlbom et al. 2001, Litvak et al. 2002, Levallois 2002, Repacholi 1998, Rösli et al. 2003).

In Switzerland, the proportion of people with health complaints attributed to environmental exposures is unknown. Nevertheless, data exist, suggesting that these health complaints are important issues for the health sector. For example, Swiss online self-help-pages for multiple chemical sensitivities groups (www.mcs-liga.ch) or for persons who attribute their health problems to electromagnetic fields (EMF) (www.gigahertz.ch) report that there are thousands of affected individuals. Cross-sectional studies conducted in the USA reported that 3.9 % of the population in California had daily symptoms of chemical sensitivity (Kreutzer et al. 1999) and in North Carolina, 6.3 % of the population reported doctor-diagnosed 'environmental illness' or MCS (Meggs et al. 1996).

A proportion of all affected persons will eventually seek help for their health complaints (see Figure 1). Although this information is important to health service planners, no surveys have been conducted within the general population that attempt to estimate the number of people who will need help.

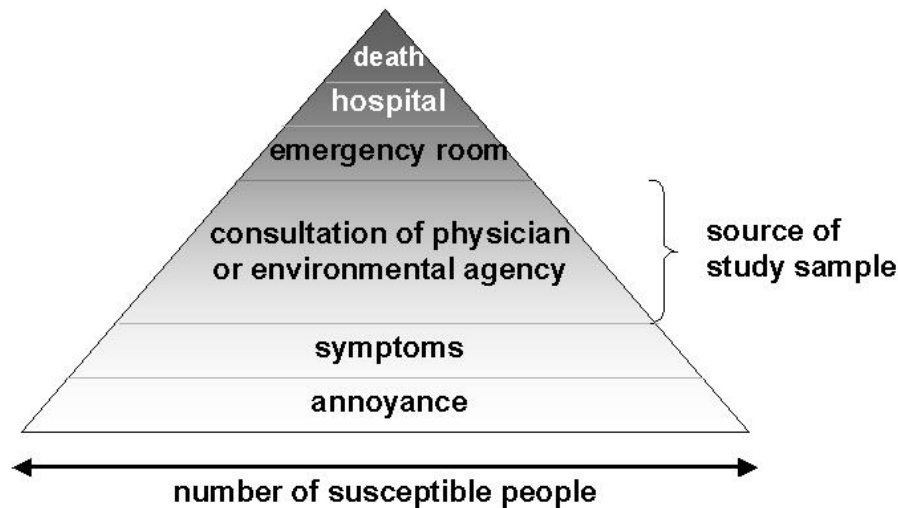


Figure 1: Pyramid of increasingly severe potential health effects from environmental exposures

To estimate the magnitude of environmental medicine counselling in general practice, a questionnaire survey was conducted in 2002 in collaboration with the 'Swiss Sentinel Surveillance Network'; a representative sample of physicians who report regularly on infectious diseases to the Swiss Federal Office of Public Health. In addition, data collected of consultations over the period of one year from several Swiss environmental agencies was obtained.

Health sectors in many European countries and in the US and Canada have responded to a perceived need of environmental medicine counselling by expanding occupational health services to include environmental medicine centres (Ahlborg 2000; Sabo et al. 2000) and by establishing outpatient clinics for environmental medicine (Seidel 2002). No such service exists within the health sector in Switzerland. People complaining about symptoms that they attribute to the environment either consult their general practitioner or environmental protection agencies responsible for chemical safety or air hygiene. However, both the

physicians and the environmental agencies are hindered by the inadequate knowledge of each other's area of specialisation. Furthermore, it is well known that psychological factors can contribute to the development or maintenance of unspecific health complaints (Uexküll 1997).

To evaluate the need and the feasibility of an interdisciplinary service for environmental medicine, a research project was initiated in January 2001 at the University of Basel, Switzerland. Cooperation agencies included several university institutes, regional and local environmental agencies and the Swiss Federal Office of Public Health. The project was a continuation of an already existing ad hoc cooperation between these agencies. During a pilot project, restricted to a one year period, an interdisciplinary team systematically assessed the medical, psychological-psychiatric and environmental background of persons who attributed their health problems to environmental exposures and, subsequently, offered advice to the participants. An evaluation interview assessed participants' health status and satisfaction with the project approximately half a year after counselling.

This thesis focuses on the need for environmental medicine consultations in Switzerland. In a second step, characteristics of persons who attribute health complaints to environmental exposures are compared to a representative (symptomatic) sample of the Swiss population. Results of the medical, psychological-psychiatric and environmental assessments are analysed. In a subsample of project participants who attributed their health complaints to EMF, EMF-exposures are put into context with systematically conducted examinations and are discussed critically against the background of incongruities of the existing Swiss legal threshold values. Finally, the project evaluation is presented and conclusions are drawn for the health care system in Switzerland.

1.2 Objectives and structure of this thesis

1.2.1 Goal of the environmental medicine project

Goal of the environmental medicine project was to develop a model of an environmental medicine counselling structure and to test its implementation in a pilot project, including the analysis of the results and the evaluation of the project. Another goal was to assess the magnitude of environmental medicine consultations in general practice in Switzerland.

1.2.2 Main objectives of this thesis and used methods

In the following, the specific research questions are introduced, the means by which the questions were answered and the chapters where they are addressed.

A summary of the findings is presented in chapter 5.1.

I) *What is the magnitude of environmental medicine counselling in general practice in Switzerland?*

During 2002, the nearly 250 physicians who participate in the 'Swiss Sentinel Surveillance Network', were asked to record the number of patients with environmental health problems, using a specific questionnaire. In addition, the Swiss Federal Office of Public Health provided data of weekly consultation numbers of all Sentinella physicians as well as data from consultations of several local and national environmental agencies or private laboratories.

In chapter 2.1, results of this survey are presented and put into context with data from the environmental medicine counselling project in Basel.

II) *What are characteristics of the environmental medicine project participants (e.g. attitude towards stress, use of 'alternative' health care services, reported illnesses), compared to a representative (symptomatic) sample of the Swiss population?*

The environmental medicine project counselled people who related their health pro-

blems to environmental exposures. All participants filled in an entry questionnaire. For reasons of comparability, this questionnaire included questions from the Swiss Health Survey (1997) (Bundesamt für Statistik 2000). In chapter 3.1 entry questionnaire items are compared to identical questions of the Swiss Health Survey from 1997 with emphasis on a "symptomatic" comparison group (persons who indicated having "physical or psychological problems that restricted them in everyday activities, lasting for more than one year", ~17 % of the survey).

IIIa) What are the main findings of the medical, psychological-psychiatric and environmental assessments?

IIIb) How do health complaints and suspected exposures correspond to the findings of the medical, psychological-psychiatric and environmental assessments?

The standard assessment included three investigations: The medical examination emphasised on allergology and internal medicine. The psychological-psychiatric examination included two types of clinical interviews: a partially structured interview to assess conflicts and personality structure was followed by a computer-structured interview to determine the subject's diagnosis according to ICD-10. In addition, participants were instructed to fill in psychometric questionnaires. The environmental investigation by the environmental hygienist included a home visit as well as standard measurements of indoor climate parameters.

All results were discussed in joint case conferences. In chapter 3.1, the results of the three assessments as recorded in the joint case conferences are presented, as well as the plausibility of the findings' context with the reported health complaints.

IVa) What EMF exposure level can be found in the subgroup of participants who attributed their health complaints to electromagnetic fields?

IVb) How can the results of the measurements be evaluated with respect to their health relevance?

IVc) How do reported health complaints correspond to the findings of the electromagnetic field (EMF) measurements?

In the subgroup of cases where participants suspected EMF as cause of the symptoms, in addition to the standard investigations, participants were visited by an expert who measured EMF-exposure at home.

For the evaluation of the health relevance of the assessed electromagnetic fields, a set of criteria was developed.

On the basis of the developed criteria, the findings of the EMF-assessments, the medical, psychological-psychiatric and (biological and chemical) environmental investigations were rated with respect to their plausibility as a cause of the reported health complaints. All these results are presented in chapter 3.2.

V) How do the complainants describe their health approximately half a year after participation in the environmental medicine project? How many were successful in the implementation of given advice, and were the expectations into the project fulfilled?

After the case conferences, the project participants were counselled, followed by an evaluation interview approximately half a year later. The questionnaire for this telephone interview focused on process-oriented questions (e.g. satisfaction with the duration of examinations) as well as result-oriented questions (e.g. changes in the health status after participation in the project). Chapter 4.1 gives a brief overview of the results of the interview.

2 Prevalence of environmental medicine problems in Switzerland

2.1 Are environmental medicine problems relevant in Switzerland?*

*published as: *Huss, A., J. Küchenhoff, A. Bircher, M. Niederer, J. Tremp, R. Waeber, C. Braun-Fahrländer, and for the Swiss Sentinel Surveillance Network, Are environmental medicine problems relevant in Switzerland? Swiss Med Wkly, 2004. 134: p. 500 - 507.*

Are environmental medicine problems relevant in Switzerland?

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Summary

Background and aim: In Switzerland, the prevalence of health problems attributed to environmental exposures is unknown, and views differ regarding its magnitude. In the present study we investigated the frequency of environmentally related health problems amongst the patients of Swiss sentinel physicians and assessed symptoms and suspected environmental exposures.

Methods: During 2002, nearly 250 “Swiss Sentinel Surveillance Network” physicians were asked to record the number of patients presenting with environmental health problems and to complete a questionnaire inquiring about suspected environmental exposures and health problems. Physicians offering “alternative” medical therapies also participated in the study. The results were compared with the experience of a Basel University pilot project which evaluated patients with environment-related health problems simultaneously from the medical, psychiatric and environmental viewpoint.

Results: 354 environment-related consultations were reported by 72 physicians, corresponding to 0.03% of all sentinel-physician consultations. There were considerable differences both within the group of Sentinella physicians, and between physicians offering “alternative” medical therapies and the Sentinella physicians, in the frequency of environmentally-related consultations, the character of the reported symptoms and the suspected environmental exposures.

Conclusion: Overall, environmental medicine consultations in general practice were rare. However, experience of the environmental medicine pilot project showed that concerned persons seek help from various health care providers and from environmental agencies. Effective treatment should include counselling by medical, psychiatric and environmental professionals.

Key words: *Sentinella; environmental medicine; counselling*

The environmental medicine project, No. F3/00, was financed by the Foundation ‘Mensch – Gesellschaft – Umwelt’, University of Basel, the Swiss Federal Office of Public Health, the Swiss Agency for the Environment, Forests and Landscape and the foundation AHA! – Asthma Haut Allergie, Bern, and the University Hospital Basel research fund.

Introduction

In Switzerland, the prevalence of persons with health problems attributed to environmental exposures is unknown. No peer-reviewed studies have been published, but according to some of the self-help pages for “multiple chemical sensitivities” (MCS) groups (www.mcs-liga.ch) or persons who ascribe their health problems to electromagnetic fields (www.gigahertz.ch), for example, there are thousands of individuals in Switzerland who are concerned. These figures suggest that health problems due to environmental exposure are an important issue in the health sector. US studies have reported that 3.9% of the population in a cross-

sectional study in California had daily symptoms of chemical sensitivity [1]. A study in North Carolina reported 6.3% of the population with doctor-diagnosed “environmental illness” or “MCS” [2].

What do people do when they feel that their health problems are caused by environmental exposures? In contrast to other countries [3–5], Switzerland does not offer environmental medicine counselling within an institutional structure. While some people see their doctor about such conditions, others may seek advice from an environmental agency, e.g. agencies responsible for chemical safety or air hygiene.

The first aim of this study was to estimate the scale of environmental medicine counselling in Switzerland.

For this estimation we had two different data sources. The main source was the frequency of medical consultations due to environmental exposures in general practice. In collaboration with the "Swiss Sentinel Surveillance Network" ("Sentinella"), physicians' case notifications for medical problems ascribed to environmental exposure were recorded during one year. The need for environmental medical advice was also assessed in a one-year environmental medicine pilot project conducted at the University of Basel. This pilot

project evaluated patients who attributed their health problems on environmental exposure using medical, psychological and environmental tools [6]. The results of this pilot project were added as a second information source.

A second aim of the study was to analyse whether health problems and suspected environmental exposures differed between groups of physicians and the complainants of the environmental medicine pilot project.

Finally, plausibility ratings concerning a causal relation between the symptoms and the suspected exposures conducted by the physicians and the project research team were compared.

Methods

Sentinel network: Assessment of consultations due to environment-related medical problems

The Swiss "Sentinella" network is a joint project of the Swiss Federal Office of Public Health and the University of Berne. 150–250 general practitioners (GPs), internists and paediatricians in private practice have been reporting weekly morbidity data since 1986. In 2002 the physicians taking part represented 3.37%, 2.76% and 6.25% respectively of all GPs, internists and paediatricians. These percentages refer to practitioners aged less than 65 years. Nearly all Swiss Cantons are represented by at least one regularly reporting physician (www.bag.admin.ch/sentinella/). The main reporting topics are infectious diseases such as influenza-like illness, measles, mumps, rubella, chickenpox, etc. Where one patient has seen the doctor several times for the same health problem, only one consultation is recorded. Physicians record the number of consultations on a weekly basis.

The Swiss sentinel physicians agreed to record the frequency of environmentally related problems during the year 2002 on the official questionnaire of the Swiss Federal Office of Public Health, and to supplement the information recorded with an additional environmental medicine questionnaire.

Data concerning the Swiss sentinel physicians (e.g. age, sex, region) was obtained from the Swiss Federal Office of Public Health.

It has been suggested that people with environmental sensitivities use the health care system more often [7] and are more likely to seek help outside the traditional medical sector. We had found evidence of this in the Basel environmental medicine pilot project [6], and therefore invited additional general practitioners offering "alternative" therapeutic methods (e.g. homoeopathy) to participate in the present study. Four out of ten physicians contacted agreed to participate.

The main inclusion criterion for an environmental medical consultation was that either the patient or physician or both suspected environmental exposures as the cause of the health problem. Environmental exposures perceived, but not necessarily verified, as the cause of health problems, such as food additives, electromagnetic fields or amalgam, were included as environmental exposures. For brevity, we excluded "classic allergens" such as animal dander, pollen, mites or medication from the list of environmental exposures.

Additional environmental questionnaire

In the environmental medicine questionnaire, physicians could tick up to 22 symptoms and 25 exposure items, or provide information in free text. Health problems were

classified into nine groups: (a) unspecific symptoms, (b) general symptoms, (c) respiratory symptoms or irritations of eye, nose or throat, (d) cutaneous symptoms or allergies, (e) cardiac or circulatory problems, (f) gastrointestinal symptoms, (g) infections, (h) muscular or joint problems or rheumatological symptoms, or (i) "other". Environmental exposure was divided into: indoor exposures, radiation (with the subgroup electromagnetic fields), outdoor exposures, noise, amalgam, food additives and "other".

Further questions were included to gather demographic data and information on the duration of symptoms. Physicians were asked to indicate whether a causal relationship between the reported illness and the suspected exposure seemed "unlikely", "possible" or "likely". Information on the patient's treatment (counselling, therapy, provision of further information from environmental agencies, etc) was assessed.

Data analysis

To estimate the scale of environmental medical problems, we assessed the number of environment-related case notifications as a percentage of all consultations, the analyses being confined to physicians who reported the total number of consultations per week.

As a next step, patients' demographic data, health problems and suspected exposures were compared. Group differences were assessed by Kruskal-Wallis or χ^2 test. The prevalence of reported symptoms and suspected exposure was calculated from proportions of ticked items within the symptom or exposure categories. Mantel-Haenszel odds ratios were calculated for the reported symptom and exposure groups, where patients reported at least one item of the respective groups.

Physicians reporting cases were compared with physicians who reported no cases with respect to demographic data, region and type of area, using Fisher's exact, χ^2 or Wilcoxon tests. The mean number of cases per physician and year was compared between specialties, region and type of area using the Kruskal-Wallis test.

To estimate the prevalence of annual environment-related medical consultations in Switzerland we assessed the proportion of each physician's environment-related consultations. We averaged these estimates across physicians in the separate specialties and weighted them using the mean number of consultations (per physician and year) within the speciality as well as the number of physicians in the speciality in Switzerland. Finally, the physicians' assessment of the causality rating of health symptoms and environmental exposures are presented. All calculations were performed using STATA 8.

Results

Frequency of environment-related medical problems

Of the 223 sentinel physicians who reported consultation numbers (92% of all Sentinella physicians), 64 (29%) reported at least one environment-related case in a one-year period.

One of the four "alternative" physicians did not report weekly consultations, and thus a total of 226 physicians reported total physician-patient encounters, amounting to nearly a million. These physicians reported a total of 331 environment-related consultations, representing 0.03% of all consultations. Among the "alternative" physicians the proportion was 0.29% (28/9660 consultations). One of the sentinel physicians reported 158 cases, a yield of 4.2% (158/3727 consultations, "frequently reporting physician"). The proportion among the rest of the sentinel physicians who reported environment-related cases was 0.054%.

During the year 2002, 63 persons participated in the Basel environmental medicine pilot project [8] serving a target population of some 450,000 residents (consultation frequency approx. 0.014%).

Characteristics of physicians reporting cases

Of all the physicians who reported patients with environment-related medical problems, 98% returned a questionnaire. Of a total of 354 questionnaires returned, 315 (89%) were sent back by the sentinel physicians and 39 (11%) by the "alternative" physicians.

The median age of physicians reporting cases was the same as that of non-reporting physicians (50 years, $p = 0.8$). The percentage of female physi-

cians was 13% vs. 18% ($p = 0.3$). Table 1 shows the percentage distribution of reporting physicians between specialities, Swiss regions and type of region. Except for GPs, who reported cases significantly more often than physicians in the other specialities ($p = 0.01$), none of these factors differ to a statistically significant degree. The mean number of cases per physician and year within a speciality, region or type of area also differs significantly only by the physician's specialisation ($p = 0.005$).

Characteristics of patients with environment-related problems

Table 2 compares patients' demographic data, reported symptoms and suspected types of exposure between the sentinel physicians, the "alternative" physicians and the environmental medicine pilot project. The frequently reporting sentinel physician is considered separately from the rest of the sentinel physicians. The sex distribution of the patients differed slightly between the four groups ($p = 0.1$), with more women in the "alternative" physicians group. Among patients over 18, participants in the environmental medicine project were significantly older than the rest (group difference $p = 0.0003$) and youngest in the "frequently reporting physician" group. Patients of the "alternative" physician group reported significantly more symptoms (3.6 per patient) than patients of the other two physician groups (2.4 sentinel, 2.6 "alternative" physician patients). Participants in the environmental medicine project reported 3.2 symptoms per participant (group difference $p = 0.0001$). All patients of the environmental medicine pilot project reported symptom durations

Table 1

Number of physicians reporting any case and mean number of cases per physician and year, by specialty, region and type of area.

Sentinella physicians ...	n	reported any case, n (%)	mean number of cases per physician and year ^a
Total		64 (29)	0.82
Speciality			
GPs	132	46 (35)	1.2
Internists	60	15 (25)	0.5
Paediatricians	31	3 (10)	0.13*
Region			
West incl. Geneva	52	13 (25)	1.0
Berne and Jura	47	17 (36)	0.67
Northwest	32	10 (31)	0.7
Central	19	4 (21)	1.1
Northeast incl. Zurich	58	15 (26)	0.76
Ticino and southeast	15	5 (33)	0.6
Type of area			
Urban	40	8 (20)	0.85
Residential	66	19 (29)	0.72
Industrial	76	24 (32)	0.9
Agricultural/ touristic	41	13 (32)	0.7

^a Excluding a physician who reported a total of 158 cases in one year,

* group difference between specialties, $p = 0.005$

Table 2

Comparison between patients of the Sentinella physicians, "alternative" physicians and the environmental medicine pilot project: demographics, reported symptoms and suspected environmental exposures.

Patients (n) of the ...	Sentinella physicians (157)	Alternative physicians (39)	Frequently reporting physician (158)	Environmental medicine pilot project (63)
Demographics				
% of female patients	54	74	61	60
Median age of adult patients	43.5	43	27	55
% of patients with symptom duration of months or years (in contrast to days or weeks)	54	79	99	100
Reported health problems in%, (n)				
Mean number of symptoms	2.4	3.6	2.6	3.2
Unspecific, general symptoms	34.1% (126)	52.2% (71)	58.3% (240)	38.6% (78)
Irritations of eye, nose, throat	37.8% (140)	24.3% (33)	7.8% (32)	25.7% (52)
Cutaneous symptoms/allergies	10.8% (40)	9.6% (13)	6.3% (26)	6.9% (14)
Cardiac, circulatory problems	2.4% (9)	0.7% (1)	1.0% (4)	3.5% (7)
Infections	2.4% (9)	2.2% (3)	2.7% (11)	2.5% (5)
Gastrointestinal symptoms	1.9% (7)	5.1% (7)	2.9% (12)	7.9% (16)
Muscular, rheumatological problems	2.7% (10)	1.5% (2)	8.3% (34)	3.0% (6)
Other symptoms	8.1% (30)	4.4% (6)	12.9% (53)	11.9% (24)
Suspected exposures, % (n)				
Mean number of suspected exposures	1.4	1.6	1.1	2.0
Indoor exposures	26.6% (58)	27.0% (17)	4.0% (7)	35.6% (47)
Radiation (incl. EMF)	11.9% (26)	7.9% (5)	2.3% (4)	22.0% (29)
Exposures from outdoor source	34.9% (76)	23.8% (15)	4.6% (8)	12.1% (16)
Noise	1.8% (4)	1.6% (1)	1.1% (2)	5.3% (7)
Amalgam	2.8% (6)	23.8% (15)	87.4% (153)	0.0% (0)
Food additives	1.4% (3)	11.1% (7)	0.6% (1)	3.0% (4)
Other exposures	22.5% (49)	6.3% (4)	1.1% (2)	22.0% (29)

Table 3

Comparison between patients of the Sentinella physicians, 'alternative' physicians and the environmental medicine pilot project: 5 of the patients for whom the environmental medical problem was the main reason for consultation, person who suspected environmental exposure and physicians' estimate of a likelihood of a relationship between the exposure and the health complaints.

	Env. medical problem was main reason for consultation	Environmental exposure suspected by (%)			Physician's estimation of causal relationship (%)		
		physic.	patient	both	unlikely	possib.	likely
Sentinella physician patients (157)	61%	15.3	47.3	37.3	19.6	33.8	46.6
Alternative physician patients (39)	48%	42.8	53.6	3.6	13.5	13.5	73.0
Frequently reporting physician pat. (158)	99%	9.5	1.3	89.2	1.3	54.3	44.4

of months and years, whereas 46% of the patients visiting a sentinel physician indicated symptom durations of days or weeks.

Respiratory problems (especially cough) and irritation of eyes, nose and throat were the most common symptoms among the patients of the sentinel physicians and the environmental medicine project. Patients of the "alternative" GPs reported general symptoms as the most prevalent, especially fatigue, which was reported by more than half. The patients of the "frequently reporting physician" group complained most often of fatigue and headache. Participants in the environmental medicine project tended to suspect more environmental exposures as the cause of their health problems than the other physicians' patients (see table 3). The least number of environmental exposures per

patient was suspected by patients of the "frequently reporting physician". Exposure to an outdoor source, in particular ozone and particulate matter, but also electromagnetic fields, was most often suspected of causing health problems in the sentinel physicians' patient group. Patients of the "alternative" physicians reported indoor and outdoor exposure forms and amalgam in about equal proportions. The "frequently reporting" physician chiefly reported amalgam exposure in his patient group, while the environmental medicine project group listed indoor exposures and radiation (mainly electromagnetic fields) as the main exposure sources.

Some exposure types were reported significantly more often in connection with specific symptom groups. Outdoor and indoor forms of ex-

posure were usually suspected in association with irritation of eyes, nose and throat, whereas food additives were most often listed in conjunction with skin problems/allergies, infections or gastrointestinal symptoms. Amalgam was suspected of causing rheumatological and muscular, general or unspecific symptoms. Radiation exposure (usually electromagnetic fields) was usually matched with cardiac/ circulatory problems, unspecific or general symptoms.

Table 3 shows how often the environmental problem was the main reason for consultations, whether the physician and/or the patient suspected the environmental exposure to be related to the patient's symptoms, and what was the physicians' rating of the likelihood of a causal relation between the suspected environmental exposure and the health problem.

For nearly half the "alternative" physicians' patients, some 60% of the Sentinella physicians' patients and practically all those of the "frequently reporting physician", environmental problems were the main motive for the consultation.

In the Sentinella physicians' group environmental exposures were suspected by either the patient or both physician and patient, whereas among "alternative" physicians either the physician or the patient suspected the environmental exposure to be related to the health problem. The "frequently

reporting physician" and his patients usually agreed on the suspected exposure.

The "sentinel" physicians were most sceptical about a causal relationship between environmental exposure and the health problem. "Alternative" physicians and the "frequently reporting physician" were more inclined to rate environmental exposure as the likely cause of the patient's symptoms.

Sentinella physicians rated ozone, traffic exhaust and particulate matter a "likely" cause of health problems, whereas electromagnetic fields, indoor exposure to e.g. paint, varnish or solvents and amalgam were more often rated unlikely. These ratings were not affected by the Sentinella physicians' demographic characteristics.

The "alternative" physicians identified most often amalgam, ozone and insecticides as the "likely" cause. The "frequently reporting physician" suspected amalgam to be a likely or possible cause for 95% of the patients who consulted him for environment-related symptoms.

In only 11 cases (3%) did the physicians indicate on the questionnaire that they needed further background information for adequate management of the patient. Seven of the Sentinella patients and one patient of the "alternative" physicians were recommended to seek help from an environmental agency.

Discussion

In our study, environment-related medical counselling in general practice was relatively rare, with some 70% of physicians reporting no case during the year. Physicians who offer "alternative" therapies reported more cases than most of the Sentinella physicians. However, the ratio of environment-related consultations to all consultations was not very high and exceeded 0.3%, or some 10 patients per year, only once in our sample of nearly 250 physicians.

The four "alternative" physicians who participated in our sentinel study counselled approximately 10 patients a year, which corresponds closely to a German study reporting 11 environment-related consultations per year in a group of physicians who expressed explicit interest in contributing to research in environmental medicine [9]. The "alternative" physicians in our study may also represent a sample of physicians interested in environmental medicine and thus be comparable to the German sample. 15 physicians in the Sentinella group, including the "frequently reporting physician", reported training in homoeopathy or traditional Chinese medicine (TCM). If the "frequently reporting physician" is excluded, these "alternative" sentinel physicians did not report more cases than the other Sentinella physicians. However, we cannot assess whether we were able to identify all "alternative" physicians in the Sen-

tinella group. In addition, the sample is too small and the data are too heterogeneous to allow more general conclusions on this group.

A rate of 0.03% of all consultations seems low. However, when the case notifications of the 3.6% of family doctors participating in the Sentinella system are extrapolated to all GPs and internists in Switzerland, the result would be 5707 (95% C.I. 4260–7150) environment-related consultations within one year. This is a conservative estimate which excludes the "frequently reporting physician", since it may have been pure chance to have one physician in the group reporting so many cases. On the other hand, the "frequently reporting physician" may represent a rare group of physicians specialised for environmental medicine problems. Including this physician in the estimate yields an additional 5812 cases per year.

Moreover, there may be reasons for underreporting. Among others, not all concerned persons necessarily consult a GP, since they may suspect the physician of lacking environmental background knowledge. In the environmental medicine project only 69% of participants reported having seen their GP. Some patients may turn to an environmental agency for advice.

One may speculate that reporting of environment-related cases is linked to the fact that specific physicians are more aware of the problem and thus

report cases more often. For example, older physicians may be less likely to consider environmental exposures as causes of health problems than their younger colleagues. However, this is not supported by our data. If GPs report more cases this may be because they have different patients from internists or paediatricians.

Sentinella physicians tended to relate health problems to environmental exposures such as outdoor air pollution, for which a context to respiratory symptoms has been shown in a range of publications [10–15]. Health effects from indoor pollution sources are more controversial, especially at low levels, and have only been clearly demonstrated for some specific exposures (e.g. formaldehyde). Health effects of electromagnetic fields or amalgam are even more controversial. It may be speculated that the heterogeneity in the scientific community's and the media's discussion of causality is mirrored in the physicians' reporting of environmental cases in our study: Apparently the "alternative" physicians participating in our study were less likely than the other physicians to reject a connection between such environmental exposures and their putative adverse health effects. This may account for a larger number of reported cases and higher attendance by concerned persons in such practices.

Similarly, the environmental medicine project participants relied significantly more often on services of the "alternative" health care sector than a representative symptomatic group in the Swiss population [6], an observation that has also been reported in other studies [7].

The physicians participating in this study had to judge whether the relationship between the patients' symptoms and environmental exposure was probably or possibly causal. Sentinella physicians were more sceptical about a causal relationship than "alternative" physicians but they did not differ in their estimate of a "possibly" causal relationship which they reported for more than 80% of their patients. In the Basel environmental medicine project, where patients underwent a detailed medical, psychological and environmental assessment, the interdisciplinary project team consid-

ered the health symptoms of only 40% of the participants to be possibly linked to environmental exposure. 46% of the symptoms could be explained by psychological-psychiatric factors alone [6]. The high proportion of a possible causal relationship estimated by the physicians in the present study may reflect physicians' preferentially reporting an "environmental medicine case" when they consider the association to be real. This would, on the other hand, imply that only those cases were reported.

The prevalence of environmentally-related medical consultations in general practice is rather low. However, experience of the Basel pilot project suggests that many of these patients suffer from long-standing and complex health problems, need much consultation time, have sought help from various health care providers, thus producing additional costs, and could, at least in part, profit from an interdisciplinary assessment of their health problems [6, 8]. Successful implementation of the project team's recommendations was not restricted to participants whose symptoms were plausibly related to environmental exposure [8] but also included medical and psychiatric advice. Combining medical, psychiatric and environmental expertise to provide a structured intervention in the health sector would offer the best means of effectively counselling and treating patients with environmentally-related diseases.

Acknowledgements: We express particular thanks the physicians of the Sentinella network, the colleagues from the Basel area (outside the Sentinella network) and the persons in charge of the Sentinella network, especially Dr. med Julius Caesar, for their substantial support of this project. We also would like to thank Dr. S. Dunkelberg for sharing the environmental medicine questionnaire used in Hamburg.

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Annex: Environmental medicine questionnaire

Doctor code:
 Week:
 Date of birth: Month Year
 Sex: m = 1, f = 2

Environmental problem main reason for seeing doctor = 1, subsidiary reason = 2
 Environmental exposure suspected by doctor = 1, by patient = 2, both = 3

1. Nature of symptom(s) *(Several may be mentioned, please underline main symptom)*

<input type="checkbox"/> Fatigue/loss of energy	<input type="checkbox"/> Memory/concentration lapses	<input type="checkbox"/> Eye irritation	<input type="checkbox"/> Back/neck pain
<input type="checkbox"/> Insomnia	<input type="checkbox"/> Vertigo/giddiness	<input type="checkbox"/> Nose, pharynx, throat irritation	<input type="checkbox"/> Rheumatic symptoms
<input type="checkbox"/> Depressive mood	<input type="checkbox"/> Headache	<input type="checkbox"/> Cough	<input type="checkbox"/> Cardiovascular symptoms
<input type="checkbox"/> Anxiety	<input type="checkbox"/> Sensory disturbance	<input type="checkbox"/> Asthmatic symptoms	<input type="checkbox"/> Dysmenorrhoea, menstrual disorders
<input type="checkbox"/> Aggressivity/irritability	<input type="checkbox"/> Diarrhoea, constipation, intestinal cramps	<input type="checkbox"/> Cutaneous rash	<input type="checkbox"/> Other:
<input type="checkbox"/> Autonomic nervous system disorders	<input type="checkbox"/> Susceptibility to infection	<input type="checkbox"/> Itching	

More detailed description if any:

2. Suspected cause *(Several causes may be mentioned)*

Substances/substance groups: <input type="checkbox"/> Food additives <input type="checkbox"/> Odours/perfume <input type="checkbox"/> Insecticides <input type="checkbox"/> Wood preservatives <input type="checkbox"/> Paints, varnishes, solvents <input type="checkbox"/> Carpet <input type="checkbox"/> Glue <input type="checkbox"/> Amalgam <input type="checkbox"/> Formaldehyde	<input type="checkbox"/> Asbestos <input type="checkbox"/> Passive smoking <input type="checkbox"/> Ventilation/air conditioning <input type="checkbox"/> Other <input type="checkbox"/> Mould/damp Air pollutants outdoor: <input type="checkbox"/> Ozone <input type="checkbox"/> Traffic exhaust <input type="checkbox"/> Particulate matter <input type="checkbox"/> Other air pollutants	Radiation: <input type="checkbox"/> UV radiation <input type="checkbox"/> "Electrosmog" <input type="checkbox"/> Radioactive radiation/radon <input type="checkbox"/> Water veins/ground radiation Noise: <input type="checkbox"/> Aircraft <input type="checkbox"/> Traffic <input type="checkbox"/> Leisure <input type="checkbox"/> Other causes:
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3. Since when has the problem existed? *(Main symptom only)*

Days:
 Weeks:
 Months:
 Years:

4. Place of exposure *(Several places may be mentioned)*

Interior of dwelling
 Vicinity of dwelling
 Workplace/school
 Other

5. Relation of symptoms to environmental exposure

	According to patient	According to doctor
Unlikely:	<input type="checkbox"/>	<input type="checkbox"/>
Possible:	<input type="checkbox"/>	<input type="checkbox"/>
Probable:	<input type="checkbox"/>	<input type="checkbox"/>
Highly probable:	<input type="checkbox"/>	<input type="checkbox"/>
Not assessable:	<input type="checkbox"/>	<input type="checkbox"/>

6. Who or what made the patient aware of the problem? *(Several replies possible)*

Patient found out him/herself
 Family, friends, colleagues
 Press
 TV/radio
 Doctor
 Other:

7. Action: measures concerning environment-related medical problem *(Several replies possible)*

<input type="checkbox"/> Counselling by doctor sufficient	<input type="checkbox"/> Further diagnosis/treatment by doctor
<input type="checkbox"/> Inquiries/obtaining of background information from (environmental) agency by doctor necessary/desirable	<input type="checkbox"/> Referral to (environmental) agency
	<input type="checkbox"/> Referral to specialist

3 Environmental, medical and psychological background of the participants in the environmental medicine pilot project

3.1 Symptoms Attributed to the Environment – a Systematic, Interdisciplinary Assessment*

*published as: Huss A, Küchenhoff J, Bircher A, Pia Heller, Kuster H, Niederer M, Scartazzini G, Schwarzenbach S, Waeber R, Wegmann L, Braun-Fahrländer C. Symptoms attributed to the environment – a systematic interdisciplinary assessment. *Int J Hyg Env Health* 207(3): p. 245-54

Symptoms attributed to the environment – a systematic, interdisciplinary assessment

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Received September 23, 2003 · Revision received January 8, 2004 · Accepted January 17, 2004

Abstract

Problem: To assess symptoms attributed to the environment from an interdisciplinary perspective and to evaluate the plausibility of the participants' individual theory of a causal relationship between exposure and health impairment.

Method: We assessed the medical, psychiatric and environmental background in every participant in an environmental medicine project and discussed the explanatory value of our findings for each reported symptom.

Results: Every second participant had at least one symptom that could be plausibly explained by simultaneously occurring medical, psychological or environmental findings. In 40% of the participants the research team rated the association between an environmental exposure and the health complaints to be 'plausible'. Psychiatric disorders were frequent, but did not exclude environmentally caused symptoms.

Conclusion: Only an interdisciplinary structure including medical, psychiatric and environmental expertise is likely to adequately diagnose and advise persons with environmentally related symptoms.

Key words: Environmental medicine counselling

Introduction

Over the last decade, adverse effects of the environment on human health have become a major concern both for the scientific community and the general public. Though adverse health effects have been shown for many environmental and occupational exposures, there remain significant knowledge gaps with respect to health effects of low dose environmental exposures encountered in everyday life.

Nevertheless, many people suspect environmental exposures cause their health problems. Although the reported prevalence of symptoms caused by environmental exposures vary widely (Meggs et al. 1996; Kreutzer et al. 1999; Sabo et al. 2000), health sectors in many European countries and in the US and Canada have responded to a perceived need by expanding occupational health services to include environmental medicine centres (Ahlborg 2000; Sabo et al. 2000) and by establishing outpatient

clinics for environmental medicine (Beyer and Eis 1994; Eis et al. 1995; Seidel 2002).

In Switzerland, no such services exist within the health sector. People complaining about symptoms attributed to the environment either consult their general practitioner or environmental protection agencies, e.g. services responsible for chemical safety or air hygiene. However, both the physicians and the environmental agencies are hindered by the lack of the specific knowledge of each other's sector. Furthermore, it is well known that psychological factors can contribute to the development or maintenance of unspecific health complaints (Eberlein-König et al. 2002; Escobar et al. 2002).

Biological, psychological and sociological factors determine the development of symptoms in individuals, as has been conceptualised in the biopsychosocial model (Uexküll 1997). Thus, symptom reporting is seen as the outcome of complex interactions between these factors (Spurgeon 2002), which are probably active in all individuals at all times (Kipen and Fiedler 2002). Following this concept, adequate assessment of health complaints attributed to the environment has to include medical, psychological and environmental investigations with a subsequent interdisciplinary exchange of information and findings.

With this background an interdisciplinary environmental medicine research project was started in January 2001 at the University of Basel, Switzerland. As a pilot project restricted to a one year period, an interdisciplinary team systematically assessed the medical, psychological and environmental background of people who related their health problems to environmental exposures and, subsequently, offered advice to the participants. The aim of the

present study was (1) to evaluate those who seek help in such a project and to compare the participants to a representative sample of the Swiss population, (2) to simultaneously assess the plausibility of the health complaints from a medical, psychiatric and environmental perspective and (3) to evaluate the plausibility of the participants' individual theory of a causal relationship between exposure and health impairment.

Methods

Over the year 2001, information about the project was sent twice to all physicians in the canton Basel-Landschaft (630) and to all physicians in Basel-Stadt, whose addresses could be extracted from the electronic phone book (650). Additionally all public environmental agencies or laboratories and all private environmental agencies whose addresses were listed in the phone book (20), as well as several other private or public offices (111) were informed. During the year 2001 ten articles describing the study were disseminated to the regional and local media.

People interested in participation contacted the project coordinator directly by telephone or were given the coordinator's telephone number by their physician or one of the environmental offices or information centres. Potential participants were required to report health complaints which they related to some sort of (non-occupational) environmental exposure and to have residency in the area of Basel (cantons "Basel-Stadt", "Basel-Landschaft") to be included into the project. These criteria applied to 95 of 136 persons who got into contact with the project.

As illustrated in Figure 1, all participants in the study completed an entry questionnaire before taking part in a medical, a psychological-psychiatric examination and an

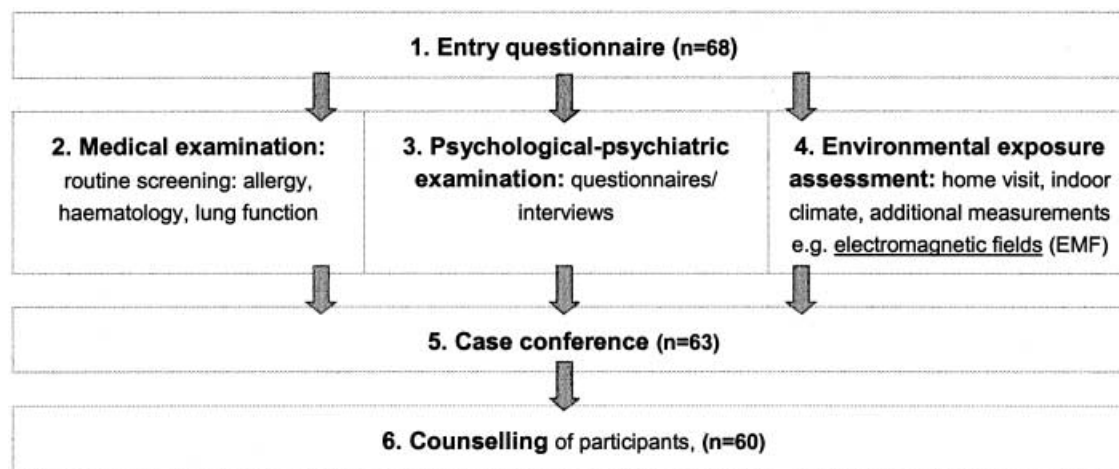


Fig. 1. Organisation of the environmental medicine investigations

environmental investigation. The results of the three investigations were discussed in case conferences that were held for each participant, where all findings, diagnoses and conclusions were recorded. Finally, counselling was offered to the participants. Sixtythree persons attended all investigations and the non-participants were interviewed by telephone about their reasons for non-participation.

The project was approved by the ethics committee of Basel and all participants gave written, informed consent.

Entry questionnaire

Every person meeting the entry criteria and willing to participate entered the study as one of the cases. We had no true controls, but were able to compare some characteristics of our study group to a representative Swiss sample by including questions from the Swiss health survey (SHS) (Bundesamt für Statistik 2000) into the entry questionnaire. The questionnaire was developed for this study, based on existing Swiss questionnaires and in collaboration with a German multicentre study (Eis et al. 2003). The SHS is based on a representative sample of 13,004 persons living in Switzerland and covers an age range of 15 to 97 years. Questions taken from the SHS asked for demographics (age, gender, education), quality of sleep (with questions regarding: difficulties falling asleep, restless sleep, waking up repeatedly at night and waking up too early in the mornings; response categories were: 'never', 'seldom', 'sometimes' or 'often'), and the use of alternative health care services (e.g. homeopathy) in the last 12 month. As all participants of the environmental medicine project suffered (by definition) health problems, they were compared to a 'symptomatic' subgroup of the SHS comprising 2229 persons who indicated having had 'physical or psychic problems that restricted them in everyday activities, lasting for more than one year' (~17% of all SHS-participants).

Medical, psychiatric and environmental investigations

The medical examination was performed by a physician in the University Hospital of Basel and included a physical examination, standard laboratory tests (blood formula, blood chemistry, total IgE, etc.) as well as an allergological screening with prick tests of 25 inhalant and six food allergens and patch tests of the European standard series. In addition, all participants underwent spirometry. Further tests were performed if necessary.

The psychological-psychiatric examination included a partially structured interview 'OPD' (Operationalised Psychodynamic Interview) that was conducted to assess conflicts and personality structure and a standardised computer-structured interview 'M-CIDI' (Munich Composite International Diagnostic Interview) to determine the subject's diagnosis according to ICD-10. The interviews were carried out by a psychologist of the Psychiatric University Hospital Basel. Participants were instructed to

complete ten psychometric questionnaires: e.g. the Symptom Check List (SCL-90-R) and the Screening for Somatic Disorders (SOMS-2J). Psychiatric diagnoses were made from the M-CIDI interview, the clinical observations and the SOMS-2J questionnaire. The diagnoses were discussed in case conferences and, in cases of doubt, defined more precisely, altered into a secondary diagnosis or dropped.

All participants were visited at home by the corresponding local environmental agency in order to register potential environmental exposures. The home visits were conducted following an adapted version of a checklist published by the Swiss Federal Office of Public Health (Binz-Deplazes and Stammbach 1998). The aim of the visits were to give a detailed description of material surroundings at home (e.g. type of renovations, type of building materials), living habits (e.g. pets at home, smoking) and environmental factors in the surrounding (e.g. emissions from industry, traffic noise). Standard measurements of carbon dioxide, relative humidity and room-temperature were carried out over 2–3 days, as well as additional measurements (18 cases) of exposures such as formaldehyde or radon if indicated. Low-frequency electric and magnetic and high-frequency electromagnetic fields (EMF) were determined by an expert if participants attributed their health problem specifically to EMF (25 cases). EMF were always measured on the bed and usually in the living room, the kitchen and in additional rooms depending on duration of stay in the respective rooms and the concerns of the participant.

Evaluation of findings with respect to each symptom

In the case conferences, the findings of the medical, psychological and environmental examinations were presented to the research team and each specialist rated the aetiological plausibility of a given complaint from his or her perspective. Plausibility from a medical perspective was based on the medical history of the participant and the findings from the medical examinations.

Plausibility from a psychiatric perspective was based on the results of the psychiatric and psychodynamic exploration, on the scientific knowledge about symptomatology in psychic disease and on the diagnosis of psychosocial stress preceding the onset of symptoms.

The plausibility from an environmental perspective was based on literature reports of given exposures, even if toxicological levels of exposure were not attained, and on the existence of a time and spatial context between a given environmental exposure and the health problem, with the prerequisite that the exposure occurred before the onset of symptoms. In addition to these criteria, in the case of electromagnetic fields, measurements had to be at least in the range of one tenth of the Swiss threshold values (low frequency magnetic field: 1 μ T, high frequency: 4–6 V/m) to be considered in the case conference. For high frequency fields, this value has been discussed in the Salzburg precautionary guidelines (Altpeter et al. 2000). The

exposure had to occur in an area where the respective person spent several hours or more each day.

Taking the information of all disciplines together, the team agreed on a final plausibility rating for each symptom from a medical, psychological and environmental perspective. The plausibility was rated on a scale, ranging from 1 'not plausible' to 5 'very plausible' which was subsequently dichotomised into a 'not plausible' (1 or 2) or 'plausible' (3–5) rating. A given symptom could have plausible explanations from several perspectives and had thus 'multiple plausibilities'. As many patients suspected environmental exposures to be related to all of their symptoms, the 'plausibility' rating had to be done for each exposure and each symptom separately. For example, we rated a persons fidgetiness or nervousness plausibly explained by 1.6 to 3 V/m high-frequency electromagnetic fields – when being in the kitchen where the exposure occurred. On the other hand, we could not explain the participant's kidney problems with EMF, but with a medical condition instead.

Re-Rating

To check for the internal consistency of the plausibility ratings, six (10%) cases were randomly chosen for re-rating. About 6–12 month later, the same team rated 14 reported symptoms and the participants' suggested environmental aetiology of symptoms for a second time.

Environmental aetiology of complaints

During the case conference, the team also rated the participants' individual theory of a causal relationship between exposure and health impairment on the 1–5 plausibility scale. An environmental origin of health problems was also considered 'plausible' if the environ-

mental exposure was a trigger of the given health complaints.

Statistical analysis

Comparison between the study population and the Swiss Health Survey (Table 1) was conducted using logistic regression models and were expressed as age-, sex- and education-adjusted prevalence rates. P-values of group differences were determined with the likelihood-ratio test. Age and educational level was compared using the two-sample Wilcoxon rank sum test. A chi²-test was used to assess gender differences.

For the analyses of the environmental aetiology of health complaints (Table 2), the detailed 5-point plausibility rating was reduced to a binary variable 'plausible' or 'not plausible', and participants with and without plausible environmental aetiologies were compared to each other. In these analyses, age and the number of symptoms or suspected exposures was compared using the two-sample Wilcoxon rank sum test. All other binary variables were compared using the Chi² or the Fisher's exact test. Analysis of the re-rating was carried out using the Cohen's Kappa interrater agreement coefficient to assess the agreement between the two ratings of the symptoms.

All analyses were performed using STATA 7.

Results

Study population

The 41 persons to whom the inclusion criteria did not apply were seeking information only (24), did not live in the region (7), presented occupational exposures (8) or did not want to be interviewed by a

Table 1. Comparison between a symptomatic subgroup of the Swiss Health Survey (SyS) and the environmental medicine project participants (EMP): demographics and adjusted prevalence of quality of sleep and use of health care services [95% C.I.].

	Symptomatic subgroup of Swiss Health Survey (SyS) (n = 2229)	SyS/EMP p-value	Environmental medicine project participants (EMP) (n = 63)
Demographics			
Mean age in years (95% C.I.)	53.3 [52.5–54.1]	0.7	54.1 [50.8–58.1]
Percentage of females	60.4%	1.0	60.3%
Low educational level	30.8%		3.3%
Middle educational level	56.7%		42.6%
High educational level	12.6%	<0.0001	54.1%
Sleep disturbance (adjusted for age, sex, education)			
'Severe' sleep disturbance	32.5 [30.6–34.5]	0.0001	57.7 [44.8–69.6]
'Pathologic' sleep disturbance	10.0 [8.6–11.6]	<0.0001	37.0 [23.9–52.3]
Use of alternative health care service (adjusted for age, sex, education)			
Acupuncture	4.7 [3.7–5.9]	0.02	12.4 [6.1–23.4]
Homeopathy	8.6 [7.2–10.2]	<0.0001	26.1 [16.4–39.0]
Herbal medicine	4.9 [3.9–6.1]	<0.0001	20.4 [11.733.2]
Manual therapy/chiropractic	12.8 [11.2–14.6]	0.0009	29.7 [19.3–42.9]
Shiatsu/foot reflex massage	5.2 [4.1–6.5]	0.03	13.0 [6.3–25.0]
Biofeedback/hypnosis	1.1 [0.6–2.2]	0.8	1.4 [0.2–6.4]

Table 2. Distribution of factors between the group of participants whose subjective theory of the environmental symptom aetiology was rated plausible or not plausible by the experts. Includes data of 62 participants. One plausibility rating could not be carried out, due to missing data of the workplace situation.

Factors	Environmental aetiology of the symptoms as rated by the project team:		
	"not plausible" n (%)	"plausible" n (%)	bivariate comparison
Total	37 (59% of participants)	25 (40% of particip.)	
Sex			
Women	22 (59%)	15 (60%)	
Men	15 (41%)	10 (40%)	p = 1.0
Age	53.9 (49.0-58.8)	55.8 (50.0-61.7)	p = 0.6
Educational level			
Low or middle	18 (49%)	9 (37.5%)	
High	18 (50%)	15 (62.5%)	p = 0.3
Median duration of 3 main symptoms (yrs.)	4.9 (2.7–10.5)	2.9 (1.0–8.6)	p = 0.3
Participant's suspected environmental exposures			
Expos. from indoor source	19 (51%)	17 (68%)	p = 0.3
Electromagnetic fields	17 (46%)	8 (32%)	p = 0.3
Expos. from outdoor surroundings	7 (19%)	7 (28%)	p = 0.5
Noise	5 (15%)	2 (8%)	p = 0.7
Other	8 (22%)	3 (12%)	p = 0.5
Number of suspected envir. exposures	1.8	2.3	p = 0.1
Reported symptoms in groups			
General symptoms	14 (38%)	9 (36%)	p = 0.9
Unspecific symptoms	22 (59%)	11 (44%)	p = 0.2
Respir. Sym., irrit. of eye, nose, throat	17 (46%)	18 (72%)	p = 0.06
Heart/ cardiovascular symptoms	5 (14%)	2 (8%)	p = 0.7
Neurological symptoms	11 (30%)	1 (4%)	p = 0.01
Gastrointestinal. symptoms	8 (22%)	5 (20%)	p = 1.0
Muscle/ joint symptoms.	3 (8%)	1 (4%)	p = 0.6
Skin rashes/ allergies	9 (24%)	3 (12%)	p = 0.3
Eye/ ear symptoms.	3 (8%)	1 (4%)	p = 0.6
Infections	2 (5%)	2 (8%)	p = 1.0
Other	2 (5%)	1 (4%)	p = 1.0
Number of symptoms	3.3	3	p = 0.7
Sensitisation			
Total IgE elevated (> 20 KU/l)	22 (59%)	21 (84%)	p = 0.08
Serological allergy test (Sx1)(> 0.35 KU/l)	13 (35%)	12 (48%)	p = 0.1
Prick test positive (at least one)	13 (35%)	13 (52%)	p = 0.2
Patch test positive (at least one)	10 (27%)	5 (20%)	p = 0.6
At least one psychiatric diagnosis	31 (83.8%)	11 (44%)	p = 0.002
Anxiety disorder (n = 8)	5 (14%)	3 (12%)	p = 1.0
Depressive disorder (n = 11)	7 (19%)	4 (16%)	p = 1.0
Personality disorder (n = 18)	14 (38%)	4 (16%)	p = 0.09
Somatoform disorder (n = 13)	10 (27%)	3 (12%)	p = 0.2

psychologist (2). Of the remaining 95 persons who were initially interested in the project and met the inclusion criteria, 92 persons specified how they learned about the project. Environmental agencies (36%) and the media (32%) were most commonly named as source of information. Seventeen subjects (18%) were referred by their physician. Sixty-eight (72%) persons returned the entry-questionnaire and 63 (66%) persons completed all three examinations.

Of the 32 non-participants, 28 could be contacted by phone and indicated the following reasons for non-participation: lack of time (9), no specific explanation (6), rethinking of the problem yielded other cause than the environment (5), project did not

comply with expectations (2), no psychiatric interview desired (1), no more medical examinations desired (1), feeling too ill to undergo further medical examinations (1), another solution of the problem was found (1), partner participating already in project (1) or registration occurred after the end of the project (1).

The mean age of the participants was 54 years, ranging from 24–84 years and 60% were female as shown in Table 1. The participants reported 202 complaints, 24 (38%) participants reported one or two symptoms, 23 (37%) three or four symptoms and 16 (25%) five or more symptoms each. The largest group of listed symptoms was 'respiratory

symptoms, irritations of eye, nose, throat' (26%) such as cough, difficulties in breathing and burning eyes. The second and third largest groups were the group of the 'unspecific symptoms' (23%) like sleep disorders, fatigue or nervousness and the 'general symptoms' (16%) such as headache, dizziness or pain.

There were 132 different exposures suspected as cause of the health complaints. Biological or chemical exposures from indoor sources (36%) were the most common. These included formaldehyde, mould, components of cleaning agents or construction materials. The second largest group were electromagnetic fields (EMF) (19%).

Only two complainants declared themselves as 'probably having MCS' (multiple chemical sensitivities).

Entry questionnaire

Participants in the environmental medicine project (EMP) had about the same age as the symptomatic subgroup (SyS) of the Swiss Health Survey (53 years) as shown in . Sex distribution was similar in both studies. The educational level measured in the survey of the EMP participants was significantly higher than that of the SyS participants.

In the analyses of the SHS, sleep disturbances were classified as 'severe' when any of the questions regarding quality of sleep were answered with 'often' and as 'pathological' when both waking up repeatedly at night and restless sleep occurred 'often' (Bundesamt für Statistik 2000). A significantly higher proportion of EMP-participants reported suffering from severe and pathological sleep disturbances than the SyS group. The use of 'alternative' medical services like acupuncture, homeopathy, etc. was more popular among the EMP participants group than among the SyS group.

Medical, psychiatric and environmental findings

The medical assessments yielded 145 medical diagnoses. The most frequently diagnosed were diseases of the respiratory system and mucous membranes (30% of diagnoses) followed by diagnoses of general symptoms (such as headache, fatigue, etc.) (22%), gastrointestinal diseases (10%), skin (9%) and neurological diseases (7%). As a subgroup, 12 (19%) participants were diagnosed with asthma (J 45).

Twentyone of the participants (33%) had no psychiatric diagnosis. Among the 42 with a psychiatric diagnosis were 19 persons (30%) with a personality disorder, 13 (21%) with a somatoform

disorder, 11 (18%) with a depressive disorder and 8 (13%) with an anxiety disorder. Twenty participants (32%) had several diagnoses.

Signs of dampness or mould were found in 12 (19%) homes. Ten (16%) homes were infrequently aired and consequently showed elevated CO₂ levels (> 1000 ppm for several hours) especially at night. No chemicals with levels described in the literature as toxicologically relevant could be measured in any of the homes. However, in five cases a relevant exposure could not be measured any more, but had evidently occurred in the past. These included pesticides (2), mixtures of diverse solvents (2) and occupational related asbestos exposure (1). All EMF exposures were below the Swiss threshold values. Nevertheless, 12 persons had a high-frequency exposure that was measured on a level between 0.6 and 2.95 V/m. Low-frequency magnetic fields were above 0.1 µT (maximum 1.3 µT) in 13 cases, in five homes both measures were elevated.

In 10 homes (16%), the environmental investigation yielded no indication of abnormal environmental exposures.

Interdisciplinary assessment of symptom plausibility

The simultaneous assessment of the symptom plausibility showed that of the reported 202 symptoms, 69 (34%) were related to medical findings, 131 (65%) to psychological-psychiatric findings and 49 (24%) to environmental exposures (3). The summation of symptom plausibility was greater than 100% because 28% of the symptoms were judged to have multiple plausibilities. At least one multiple plausible symptom occurred in 32 of the 63 participants (51%). Between the symptom groups, distributions of 'single' or 'multiple' plausibility differed considerably, as shown in Figure 2.

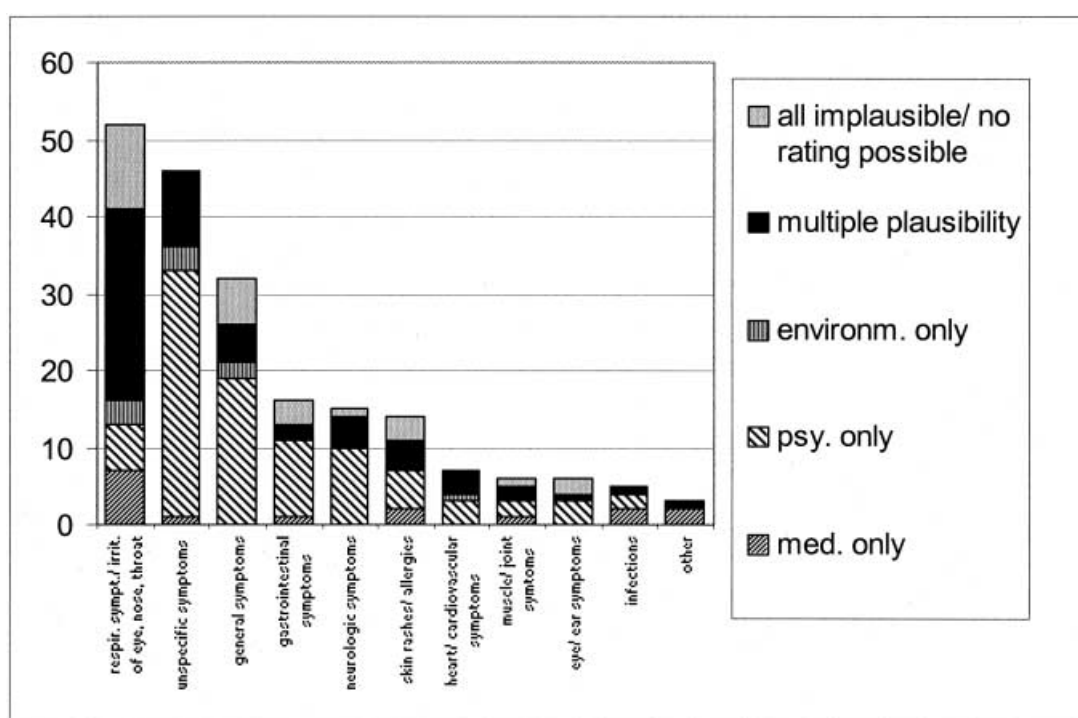
Symptoms plausibly explained by environmental exposures

On the basis of an existing allergic disease or bronchial asthma the following symptoms were considered to be plausibly triggered by environmental exposures: difficulties in breathing (8), cough (3), burning eyes (2), sensation of thoracic pressure (1), sore throat (1), running nose (2), sneezing (2). The respective exposure triggering the symptoms were: traffic exhaust, mould, allergens and chemicals such as environmental tobacco smoke, perfume, etc.

Low- and high-frequency electromagnetic fields above a tenth of the Swiss threshold of 1 µT for low frequency magnetic fields and 4–6 V/m for high frequency were plausibly related to the following symptoms: sleeping problems (5), fatigue (2), head-

Table 3. Single and multiple plausibility of symptoms

	<i>Number of symptoms</i>	<i>%</i>	<i>Occurring in n persons</i>	<i>%</i>
Sum	202	100%	63	100%
Single plausibility	118	58.4%	46	73%
Medical	17	8.4%	11	17.4%
Psychological-psychiatric	92	45.5%	37	58.7%
Environmental	9	4.5%	4	6.3%
Multiple plausibility	57	28.2%	32	50.8%
Medical and environmental	21	10.4%	12	19%
Medical and psych.-p.	17	8.4%	12	19%
Psych.-p. and environmental	12	5.9%	8	12.7%
Med. and psych.-p. and env.	7	3.5%	4	6.3%
no plausibility	27	13.3%	16	25.4%
All ratings implausible	14	6.9%	10	15.9%
No rating possible	13	6.4%	6	9.5%

**Fig. 2.** Single and multiple plausibility of health complaints by symptom group

ache (2), palpitations (1), nervousness (2), sensation of formication (1), feeling of heat and pressure in the head (1). Noise exposure and elevated carbon dioxide levels in the bedroom as a result of insufficient ventilation because of outside noise were considered to be plausibly related to sleeping problems (2), headache (1) and fatigue (1), as was formaldehyde expose as an explanation of burning eyes (2) and running nose (2). One patient had a documented occupational asbestos exposure which was plausibly related to his higher susceptibility to infections, cough and an overall decreased health status.

Kappa coefficients of the re-rated symptoms ranked between $\kappa = 0.3-0.4$ when the five point plausibility scale was considered. However, when the rating was dichotomised into the binary variable 'plausible' or 'implausible', kappa coefficients showed almost perfect agreement with respect to the medical evaluation ($\kappa = 0.9$), substantial agreement for the environmental ratings ($\kappa = 0.8$), and moderate agreement for the assessments of the psychological part ($\kappa = 0.5$). The variation in the psychological rating did not exceed two points on the detailed scale and the rating differences did not reveal any time pattern or systematical difference

between first and second rating, or divergence only in low, middle or high category.

The re-rating of the plausibility of an environmental aetiology of the health problems displayed perfect accordance ($\kappa = 1$).

Environmental aetiology of health complaints

Participants suspected a mean of 2.1 different sources of environmental exposures to be the cause of their health complaints. Altogether, 25 (40%) participants offered at least one plausible theory of an environmental aetiology of their symptoms, as shown in Table 2. Data of one person could not be rated due to missing data of the workplace situation.

Table 2 also shows the association between the environmental aetiology ratings of the research team, several demographic factors, the environmental exposure that was originally suspected by the participant to cause the health problems and the medical and psychiatric findings. In bivariate testing, environmental aetiology rated 'plausible' or 'implausible', was not related to the demographic factors or the suspected exposures. Among the medical findings, respiratory symptoms and atopy had a tendency to occur more often in the 'plausible' group whereas persons with neurological symptoms were more likely to be found in the 'implausible' group.

A psychiatric diagnosis, specifically a personality disorder was the strongest predictor for an 'implausible' rating of an environmental aetiology of a given symptom.

Discussion

Compared to a symptomatic subgroup out of a representative Swiss sample, project participants had a higher level of education, had more sleep disturbances and used alternative health care services more often.

The symptoms listed by the complainants were quite similar to symptoms reported from other environmental medicine projects and from subjects considered to suffer from 'Idiopathic Environmental Intolerance', 'Environmental Sensitivities' or MCS or other environment related health disorders (Beyer and Eis 1994; Davidoff and Keyl 1996; Bornschein et al. 2000; Bauer et al. 2001; Brölsch et al. 2001; Joffres et al. 2001; Eberlein-König et al. 2002), with a predominance of unspecific, general and respiratory symptoms. There are, however, some differences: as a symptom subgroup, sleep disorders seem

to play a more important role in the present project with 38% of participants reporting sleeping complaints as compared to 9%–18% in two German environmental medicine centres (Bornschein et al. 2000; Brölsch et al. 2001). Compared to the symptomatic subgroup of the Swiss Health Survey, project participants reported significantly more often 'severe' or 'pathologic' sleeping problems. In public discussions sleep disorders are often associated with exposure to electromagnetic fields in Switzerland (Röösli et al. 2002), but not necessarily in other countries (Levallois 2002). In our project 75% of the participants who complained about sleep disorders suspected electromagnetic fields and/or noise to be the cause of their health problems. Electromagnetic fields were the second largest group of suspected environmental exposures. This might be due to the high usage of cell phones in Switzerland and to the fact that it is a comparatively new technology with little consensus with respect to its effects on human health. EMF currently attracts frequent attention of the media. Brölsch et al. (2001) showed for Aachen, that the origin of suspected environmental exposure varies with time and area.

It has been postulated that people with medically unknown symptoms that cannot be classified using current medical classifications of disease turn to alternative health care services because they lack validation by their physicians (Sabo et al. 2000). The results of the present study support the notion of a higher use of alternative health care services although we cannot determine the reason for this behaviour. The fact that many (60%) of the project participants had tried at least one of the alternative health care services may, however, be interpreted as the patients' desperate search for help in order to improve their situation.

Project participants were more likely to have a positive skin prick test (birch, grass pollen, house dust mite, cat and dog epithelia and the mould *Alternaria*) and to suffer from asthma than a representative sample of the Swiss population (38% versus 23%, and 19% versus 7%, respectively (Wüthrich 2001)).

Thirty percent of all symptoms could partially or exclusively be explained by an underlying medical diagnosis. Thus 70% of the symptoms were not medically explained which is higher than the prevalence of 20–50% reported from studies investigating medically unexplained symptoms in different settings (Carson et al. 2000; Nimnuan et al. 2000; Feder et al. 2001; Maiden et al. 2003).

However, 46% of all symptoms could be explained by psychiatric factors alone, occurring in 59% of the participants. The prevalence of psychia-

tric disorders in patients with symptoms attributed to environmental exposures varies widely depending on the study population, sample size and applied diagnostic methods (Bornschein et al. 2001). A recent multi-centre study on multiple chemical sensitivities in Germany found psychiatric or psychosomatic disorders in 55–75% of the participants (Eis et al. 2003), a study on health disorders attributed to environmental factors reports 55% psychiatric main diagnoses (Wiesmüller et al. 2002). A British study on medically unexplained symptoms reported about 50% psychiatric morbidity among their patients (Nimnuan et al. 2001). Psychiatric disorders are also quite frequent in primary care patients, estimates ranging between 25–35% (Katon et al. 2001). Thus, the high prevalence of psychiatric disorders found in the present study is in line with previous findings of other study populations that are looking at either medically unexplained symptoms or symptoms attributed to the environment. It is, however, important to note that in half of the patients the reported symptoms were plausibly explained by concurrent findings from at least two disciplines underlining the importance of an interdisciplinary approach for diagnosis and counselling in environmental medicine.

All patients entering the project suspected an environmental exposure to cause their symptoms. We aimed at identifying factors predicting agreement between the expert and patient rating of plausible environmental causes for the health problems. None of the demographic variables nor the duration of symptoms or the type of suspected exposure were such factors. Only the group of patients with at least one psychiatric diagnosis was significantly less likely to be rated by the research team to have a plausible environmental exposure causing the symptoms. On the other hand, 40% of the patients whose subjective theory of the environmental symptom aetiology was in agreement with the expert's judgment also had a psychiatric diagnosis.

Thus, a psychiatric diagnosis does not exclude environmentally caused symptoms.

In conclusion, the results of the present study strongly suggest that only an interdisciplinary structure including medical, psychiatric and environmental expertise is likely to adequately diagnose and advise persons with environmentally related symptoms.

Acknowledgements. The Project 'Health complaints related to low-dose environmental exposures: Analysis and evaluation of an interdisciplinary environmental medicine counselling project in the Basel area', No. F5/00, was financed by the Foundation 'Mensch – Gesellschaft –

Umwelt', University of Basel, the BAG – Swiss Federal Office of Public Health, Bern -, BUWAL – Swiss Agency for the Environment, Forests and Landscape – and the foundation AHA! – Asthma Haut Allergie, Berne, and the research fund of the University Hospital Basel.

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3.1.1 Addendum to chapter 3.1.

The following addendum to chapter 3.1 presents additional results of the comparison between environmental medicine pilot project participants and participants of the Swiss health survey. These entry questionnaire items could not be included in the paper due to length restrictions. The here included questions focus on medical treatment during the past year, expenses for health care in the previous four weeks that were not covered by the health insurance, annoyance by different environmental exposures at home as well as coping styles and perceived control.

Additional questions taken from the Swiss Health Survey (SHS)

Questions taken from the SHS asked about medical treatment during the past year, for a list of diseases, expenses for health care in the previous four weeks that were not covered by the health insurance, and annoyance by different environmental exposures at home. As coping styles play an important role in physical and psychological well-being, a short form of the CISS – Coping Inventory for Stressful Situations – (12 questions, details are given below) was included. 'Coping style' refers to a characteristic or typical manner of confronting a stressful situation and dealing with it (Endler et al. 1990). The questions differentiate between problem-focussed coping ('task oriented'), emotion-oriented coping and avoidance-oriented coping. The latter was further subdivided into 'social diversion' and 'distraction' coping strategies.

The Coping Inventory for Stressful Situations (CISS) had the following instructions: "the following are ways people react to various difficult, stressful or upsetting situations. Please circle a number from 1 – 5 for each item" (answering categories from 'not at all' to 'very much') (Endler et al. 1990) and included the questions

- task: determine a course of action and follow it; try to be organized so I can be on top of the situation; think about the event and learn from my mistakes, analyse the problem before reacting.

- emotion: get angry, feel anxious about not being able to cope, blame myself for not knowing what to do, wish that I could change what has happened or how I felt.
- avoidance: a) distraction: window shop; treat myself to a favourite food or snack b) social diversion: try to be with other people, visit a friend.

As a further psychological attribute that had been shown to contribute to well-being (Bailis et al. 2001), perceived level of control was assessed by four questions.

Statistical analysis

Comparison of binary variables was done using logistic regression models in STATA 7 and were expressed as age-, sex- and education-adjusted prevalence rates. P-values of group differences were determined with the likelihood-ratio test.

The assessment of subjective perception of control and the three coping strategies ('avoidance-, task- or emotion-oriented coping) were based on four questions each. Participants rated each of the coping-items on a five-point scale ranging from (1) "not at all" to (5) "very much". The answers were summarised to a score ranging between 4 and 20. Task-, emotion- and avoidance-coping mean scores, adjusted for age, sex and education, were then determined. Avoidance-oriented coping was further subdivided into 'distraction-' or 'social diversion'-oriented coping strategies based on two questions each (resulting in scores ranging from 2 to 10 points). Adjusted mean scores of the environmental medicine project (EMP) participants were compared with the SHS participants and the symptomatic subgroup (SyS) of the SHS.

Subjective perception of control resulted in a score ranging between 4 and 17 which was subdivided into three categories (analogous to the Swiss Health Survey) indicating a low (4 – 11 points), middle (12 – 14 points) or high (15 – 17 points) level of control. Adjusted prevalence rates for the three levels of control were calculated by means of polytomous logistic regression and were compared between the different groups.

Results

Table 1 shows that a significantly higher percentage of both the SyS and the EMP group were annoyed by most of the listed environmental disturbances at home than the SHS participants. The SyS and the EMP group only differed with respect to industrial noise.

Environmental disturbance	SHS (n=13004) adjusted prevalence % (95% C.I.) ¹	SHS / SyS p-value	SyS (n=2229) adjusted prevalence % (95% C.I.) ¹	SyS / EMP p-value	EMP (n=63) adjusted prevalence % (95% C.I.) ¹
traffic noise	28.5 [27.6 – 29.4]	0.0006	32.6 [30.4 – 34.9]	0.4	38.3 [27.0 – 51.1]
industrial noise	2.4 [2.1 – 2.7]	<0.0001	3.3 [2.6 – 4.2]	<0.0001	14.0 [7.1 – 25.7]
noise of persons/children	18.9 [18.2 – 19.6]	<0.0001	23.5 [21.5 – 25.6]	0.3	16.6 [8.9 – 28.9]
traffic exhaust	9.1 [8.5 – 9.6]	0.0004	11.8 [10.4 – 13.4]	0.2	18.3 [10.4 – 30.3]
industrial exhaust/ odour nuisance	3.4 [3.1 – 3.8]	0.01	4.6 [3.7 – 6.0]	0.3	8.2 [3.4 – 18.3]
agricultural nuisance	7.7 [6.9 – 7.9]	0.7	7.7 [6.5 – 9.0]	0.3	3.7 [0.9 – 13.6]
Other	13.4 [12.7 – 14.0]	0.0001	16.9 [15.2 – 18.8]	0.01	33.9 [22.7 – 47.3]

Table 1: Comparison between the Swiss Health Survey (SHS) and a symptomatic subgroup (SyS) of the Swiss Health Survey and the environmental medicine project participants (EMP): adjusted prevalence of annoyance by environmental disturbance at home

¹ adjusted for age, sex, education

For all diseases listed in Table 2, the SyS group underwent medical treatment during the past year significantly more often than the SHS group. Among the EMP participants, a higher proportion than both the SyS group and the SHS group had undergone a medical treatment because of chronic bronchitis or allergies. More EMP participants were treated for cancer than in the SHS group.

During the past four weeks, a higher proportion of both the SyS and the EMP group had spent money on medical services that were not covered by the health insurance than the SHS group. Of those who did spend money, the SHS participants spent 96 Swiss Francs compared to 112 Francs spent by the SyS group and 151 Francs spent by the EMP group.

17% in the SHS group, 21% of the SyS group and 39% of the EMP group indicated to have spent more than 150 CHF during the past four weeks.

Medical treatment during the last year for one of the following diseases	SHS (n=13004) adjusted prevalence % (95% C.I.) ¹	SHS / SyS p-value	SyS (n=2229) adjusted prevalence % (95% C.I.) ¹	SyS / EMP p-value	EMP (n=63) adjusted prevalence % (95% C.I.) ¹
rheumatism	8.1 [7.5 – 8.7]	<0.0001	18.1 [16.3 – 20.1]	0.3	13.6 [7.4 – 23.4]
chronic bronchitis	4.8 [4.4 – 5.2]	<0.0001	10.1 [8.7 – 11.7]	0.01	23.2 [14.0 – 35.9]
high blood pressure	9.2 [8.5 – 9.8]	<0.0001	13.4 [11.8 – 15.1]	0.4	9.8 [5.0 – 18.5]
myocardial infarction	0.3 [0.2 – 0.4]	0.0003	0.6 [0.4 – 1.0]	0.5	1.3 [0.3 – 5.5]
kidney disease	2.4 [2.1 – 2.7]	0.0001	4.2 [3.3 – 5.3]	0.2	1.5 [0.2 – 10.2]
cancer/ tumour	2.0 [1.8 – 2.3]	0.0001	3.5 [2.8 – 4.5]	0.1	7.3 [3.2 – 15.9]
hay fever, allergy	11.1 [10.5 – 11.8]	<0.0001	16.9 [15.1 – 18.9]	0.0008	37.9 [26.2 – 51.2]
nervous breakdown, depression	5.0 [4.6 – 5.5]	<0.0001	13.9 [12.2 – 15.7]	0.2	8.3 [3.5 – 18.7]

Expenses (Swiss Francs) on health care that were not covered by health insurance¹

% of subjects spending any money last 4 weeks	37.8 [36.9 – 38.8]	<0.0001	46.5 [44.1 – 49.0]	0.9	46.0 [33.8 – 58.7]
% of subjects spending more than 150 Swiss francs in 4 weeks	17.2 [16.0 – 18.4]	0.02	20.7 [18.0 – 23.8]	0.03	38.6 [22.9 – 57.0]
mean amount of money (in Swiss Francs) spent in last 4 weeks	95.5 [91.7 – 99.2]	0.001	111.56 [103.1 – 119.9]	0.1	150.6 [108.1 – 193.1]

Table 2: Adjusted prevalence of self reported medical treatment for a given disease during the past year, sleep disorders, use of alternative health care, and expenses on health care that are not covered by the health insurance, comparison between the Swiss Health Survey (SHS) and a symptomatic subgroup (SyS) of the Swiss Health Survey and the environmental medicine project participants (EMP)

¹ adjusted for age, sex, education

Table 3 shows that the SyS group had a lower mean score for task-oriented coping and a higher score for emotion-oriented coping than the SHS participants, but EMP participants did not differ from SHS participants with respect to the three main coping strategies. However, when avoidance-oriented coping was subdivided into 'social diversion'- and 'distraction'-oriented coping, EMP participants scored higher on seeking social diversion and lower on distraction.

Compared to the SHS participants a significantly higher proportion of the SyS group had a low perception of control and significantly less SyS subjects indicated a high level of control. EMP participants indicated either a high or a low perception of control, whereas few ranked in the middle category.

Adjusted mean scores of coping strategies (95% C.I.) ¹	SHS (n=13004) adjusted mean scores (95% C.I.) ¹	SHS/ SyS p-value	SyS (n=2229) adj. mean scores (95% C.I.) ¹	SyS/ EMP p-value	EMP (n=63) adjusted mean scores (95% C.I.) ¹
task- oriented coping strategy	13.1 [13.0 – 13.2]	0.01	12.9 [12.7 – 13.0]	0.03	13.6 [13.0 – 14.2]
emotion - oriented coping strat.	9.8 [9.8 – 9.9]	<0.0001	10.4 [10.3 – 10.6]	0.2	9.9 [9.1 – 10.6]
Avoidance - oriented coping strat.	9.4 [9.4 – 9.5]	0.2	9.5 [9.4 – 9.7]	0.5	9.7 [9.1 – 10.4]
social diversion- orient. coping str.	5.5 [5.4 – 5.5]	0.2	5.5 [5.4 – 5.6]	0.02	6.1 [5.6 – 6.5]
Distraction- oriented coping strat.	3.9 [3.9 – 4.0]	0.4	4.0 [3.9 – 4.1]	0.02	3.5 [3.2 – 3.9]

Adjusted prevalence of different levels of perceived control (95% C.I.) ¹					
low level of control	29.3 [28.3 – 30.3]	<0.0001	42.8 [39.9 – 45.8]	0.4	37.6 [24.2 – 53.2]
middle level of control	42.4 [41.0 – 42.9]	0.03	39.4 [37.7 – 41.0]	0.03	25.5 [18.5 – 32.2]
high level of control	28.2 [27.8– 28.8]	<0.0001	17.8 [14.5 – 19.1]	<0.0001	36.9 [28.3 – 43.7]

Table 3: Comparison between the Swiss Health Survey (SHS) and a symptomatic subgroup (SyS) of the Swiss Health Survey and the environmental medicine project participants (EMP): coping strategies and perceived control

¹ adjusted for age, sex, education

Discussion

Compared to the symptomatic subgroup of the Swiss Health Survey project participants had visited a physician more than twice as often because of allergies or chronic bronchitis, health problems that are often linked to environmental exposures such as air pollution from indoor and outdoor sources.

The higher expenditures of project participants for health care not covered by health insurances may in part be a result of many of them belonging to a more affluent part of the population. Although we adjusted health care expenditures for educational level (see chapter 3.1) this may not have been sufficient control for all social class differences.

It has been argued that persons who attribute their health complaints to the environment are more sensitive towards environmental disturbances (Sabo et al. 2000), especially odours (Ross et al. 1999). Based on our data the enhanced sensitivity to environmental disturbances seems rather to be a characteristic of people with bad health than an attribute of people relating their health complaints to environment exposures as the project participants did not indicate to be more annoyed of environmental disturbances than the symptomatic subgroup of the Swiss health survey, industrial noise being the exception. The latter is probably a result of the project's restriction to the city and surrounding of Basel, which is a more urban and industrialised area compared to the whole of Switzerland.

Coping strategies are hypothesised to play an important role between the antecedents and outcomes of the stress process (Endler et al. 1990). In general, task-oriented coping styles have been associated with less depression and better perceived health status, whereas emotion-oriented coping styles are being negatively related to adaptation and good health (Cosway et al. 2000, Afari et al. 2000). Comparing the three main coping measures, the project participants did not differ from the participants of the Swiss health survey and scored even higher than the symptomatic subgroup of the Swiss health survey with respect to task oriented coping, whereas there was no difference at a statistically significant level regarding avoidance or emotion oriented coping. When the questions regarding 'avoidance' oriented coping were separated into 'social diversion' and 'distraction', project participants were again similar to the Swiss health survey participants. However, they differed significantly from the symptomatic subgroup of the survey preferring person-oriented social diversion as means of alleviating stress, in contrast to distracting themselves with other situations.

A low level of perceived control can lead to the feeling of being unable to alter or ameliorate situations which can result in resignation, helplessness and stress (Bailis et al. 2001). If this is combined with an unfavourable coping strategy, it can have negative effects on the health

status. Project participants either indicated a high or a low level of perceived control but rarely ranked in the middle category. The proportion of participants with a high level of perceived control was even higher than in the Swiss health survey whereas the symptomatic subgroup of the Swiss health survey was most likely to indicate a low level of perceived control. The large proportion of project participants with a high level of perceived control parallels the high scores for task oriented coping strategy as both characteristics are interrelated. It may be interpreted that the participants' use of the environmental medicine project as a mean to solve their health problem may reflect a more task oriented coping strategy paralleled by a high level of perceived control and, therefore, it describes psychosocial attributes characteristic for this particular group. Alternatively, it may in part reflect the high socio-economic status of our study population as high socio-economic status has been associated with a greater sense of perceived control (Bailis et al. 2001). Thus, our models may have been insufficient in controlling for social status by just including educational level.

3.2 Elektromagnetische Felder und Gesundheitsbelastungen – Bericht der Fallabklärungen im Rahmen des umweltmedizinischen Beratungsprojektes Basel [Electromagnetic fields and health complaints – report of the case evaluations in the environmental medicine project]*

**The chapter 3.2 is a short version of the report: Huss A, Braun-Fahrländer C and the environmental medicine pilot project team. Elektromagnetische Felder und Gesundheitsbelastungen – Bericht der Fallabklärungen im Rahmen des umweltmedizinischen Beratungsprojektes Basel. Bericht an das BUNDESAMT FÜR UMWELT, WALD UND LANDSCHAFT, Januar 2004*

The original (internal) report to the BUWAL includes case reports of 13 participants in the environmental medicine project. The case reports were excluded from the following text in order to ensure anonymity.

This report has been published in a revised, peer-reviewed version as:

Anke Huss, Joachim Küchenhoff, Andreas Bircher, Markus Niederer, Josef Tremp, Roger Waeber, Charlotte Braun-Fahrländer (2005): Elektromagnetische Felder und Gesundheitsbelastungen – Interdisziplinäre Fallabklärungen im Rahmen eines umweltmedizinischen Beratungsprojektes [Electromagnetic fields and health complaints – interdisciplinary case evaluations in an environmental medicine counselling project]. 10 UFP (1) 21-28 (2005)

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3.2.2 Zusammenfassung

In Form eines Pilotprojektes wurde in der Region Basel während des Jahres 2001 eine Beratung für Personen angeboten, die Gesundheitsbeschwerden auf Umweltbelastungen zurückführten. Alle Probandinnen und Probanden wurden systematisch medizinisch und psychologisch-psychiatrisch untersucht und es wurde ein Hausbesuch durch die Umweltfachstelle durchgeführt. Einen zusätzlichen Hausbesuch mit Messung elektromagnetischer Felder (EMF) erhielten Betroffene, die ihre Beschwerden spezifisch auf EMF zurückführten. Bei dem EMF-Hausbesuch wurden niederfrequente elektrische und magnetische sowie hochfrequente Felder gemessen. Die Plausibilität eines Zusammenhangs zwischen dem Gesundheitsproblem und der Belastung durch EMF wurde von dem interdisziplinären Team in einer Fallkonferenz beurteilt. Anschliessend fand eine Beratung der Studienteilnehmer statt, in der konkrete Massnahmen zur Verbesserung der Gesundheitssituation vorgeschlagen wurden.

Insgesamt vermuteten 25 von 63 (40%) Projektteilnehmer/innen EMF als Ursache ihrer Beschwerden. Dreizehn der 25 Teilnehmer/innen vermuteten Strahlung von Mobilfunkantennen, der Rest Emissionen des Hausstroms oder allgemein "Elektrosmog" als Ursache der gesundheitlichen Beschwerden. Die häufigste Beschwerde waren Schlafstörungen (14 von 25 Personen, 56 %).

Fast alle Personen in der EMF-Gruppe waren in ihrem Wohnbereich niederfrequenten elektrischen Feldern oberhalb der Nachweisgrenze von 3 V/m ausgesetzt. Eine Exposition gegenüber niederfrequenten magnetischen oder hochfrequenten elektromagnetischen Feldern oberhalb der messtechnischen Nachweisgrenze von 0.02 μ T bzw. 0.3 V/m fand sich nur bei wenigen Projektteilnehmer/innen. Alle festgestellten EMF-Messwerte lagen unterhalb der gesetzlichen Grenzwerte.

Wissenschaftliche Kausalität kann bei der Abklärung von Einzelfällen nicht nachgewiesen werden. Die interdisziplinäre Bewertung durch Experten der Fachbereiche Medizin,

Psychologie/ Psychiatrie und Baubiologie hatte vielmehr zum Ziel, unter Berücksichtigung aller erhobenen Befunde den oder die plausiblen Ursachen abzuschätzen. Eine EMF-Exposition wurde dann als plausibel mit einem Symptom zusammenhängend beurteilt, wenn

- sie einen bestimmten Schwellenwert überstieg
- sich die Person mehrere Stunden pro Tag im Bereich der Felder aufhielt und
- ein zeitlicher und ein räumlicher Bezug zwischen der Belastung und den Beschwerden gegeben war. Wichtigstes Kriterium war hierbei, dass sich das Symptom erst nach Auftreten der Belastung entwickelt hatte (zeitlicher Bezug).

Als Schwellenwerte für die EMF-Exposition wurden Empfehlungen des beigezogenen Baubiologen verwendet: niederfrequente elektrische Feldstärke: 10 V/m; niederfrequente magnetische Flussdichte: 0.1 μ T; hochfrequente Strahlung: 0.6 V/m.

Trotz der Unsicherheiten, die mit der Einschätzung von Zusammenhängen zwischen Exposition und gesundheitlichen Auswirkungen in Einzelfällen einhergehen, kam das Projektteam zur Einschätzung, dass bei acht der 25 Personen (32 %) ein Zusammenhang zwischen mindestens einem Symptom und der EMF-Exposition als plausibel erachtet wurde. Bei allen 'plausiblen' Symptomen handelte es sich um kurz- bis mittelfristige Einschränkungen des Wohlbefindens (z.B. Kribbelgefühl/ Schlafstörungen).

Psychiatrische Diagnosen wurden bei 76 % der EMF-Projektteilnehmer/innen gestellt und waren wesentlich häufiger als in der Allgemeinbevölkerung.

Trotz der hohen Komplexität der in dem Projekt behandelten Probleme mit einem hohen Anteil medizinischer und psychologisch-psychiatrischer Probleme konnte das Beratungsprojekt vielen Teilnehmer/innen entscheidende Hilfestellung geben: Bei einem Evaluationsinterview ca. ein halbes Jahr nach der Beratung beschrieben 45 %, dass mindestens einer der genannten Verbesserungsvorschläge umgesetzt werden konnte und dies einen positiven Einfluss auf den Gesundheitszustand hatte.

3.2.3 Einleitung

Der enorme Zuwachs des Mobilfunks in den letzten Jahren hat zu einer Zunahme der öffentlichen Besorgnis in Bezug auf mögliche Gesundheitsrisiken geführt. Die wissenschaftlichen Erkenntnisse zu den Auswirkungen elektromagnetischer Felder (EMF) auf die Gesundheit sind umstritten. Dies führt dazu, dass es für Personen, die gesundheitliche Beschwerden auf eine EMF-Belastung zurückführen, bislang wenig Möglichkeiten gibt, ihre Situation adäquat abklären zu lassen. Bei der Beratung Betroffener stossen Umweltfachleute und Mediziner schnell an ihre fachlichen Grenzen. Interdisziplinäre Einrichtungen, die medizinische, seelische und umweltbedingte Aspekte der gesundheitlichen Störungen miteinbeziehen, gibt es bislang in der Schweiz nicht.

In Form eines Pilotprojektes wurde in der Region Basel während des Jahres 2001 eine interdisziplinäre umweltmedizinische Beratung angeboten. Dabei handelte es sich um ein Kooperationsprojekt verschiedener universitärer und öffentlicher Stellen, u.a. des Kantonsspitals Basel, der Psychiatrischen Uniklinik, des Kantonalen Laboratoriums Basel-Stadt und des Amtes für Umwelt und Energie Liestal. Im Rahmen des Projektes konnten sich Personen melden, die ihre gesundheitlichen Störungen auf Umweltbelastungen zurückführten. Alle Probandinnen und Probanden wurden systematisch medizinisch und psychologisch-psychiatrisch untersucht und ein Hausbesuch durch die Umweltfachstelle durchgeführt. Anschliessend fand eine Beratung statt. Einen zusätzlichen Hausbesuch mit Messung elektromagnetischer Felder erhielten Betroffene, die ihre Beschwerden spezifisch auf EMF zurückführten. Dies war bei 25 von 63 (40%) Projektteilnehmer/innen der Fall. Eine derart breite Datenbasis für Einzelfälle, die eine Verknüpfung der Expositionsdaten mit Gesundheitsuntersuchungen sowie den chemischen oder biologischen Abklärungen durch die Umweltfachstellen erlaubt, gab es bislang noch nicht.

Dieser Bericht stellt in einem ersten Teil die EMF-Messmethode sowie die Expositionssituation dieser 25 Personen vor. In einem zweiten Schritt wird kurz diskutiert, welche

Symptome der Teilnehmer/innen das Projektteam als plausibel mit der EMF-Exposition zusammenhängend bewertete. Drittens werden einzelne Fallbeispiele vorgestellt, wobei ein Schwerpunkt auf die Darstellung der EMF-Exposition gelegt wird.

3.2.4 Physikalische Grundlagen

Im elektromagnetischen Wechselfeld ändert das Feld periodisch mit einer bestimmten Frequenz seine Richtung. Die Anzahl dieser Schwingungen je Sekunde wird in Hertz (Hz) ausgedrückt. Elektromagnetische Wellen breiten sich im Raum mit Lichtgeschwindigkeit ($\sim 3 \times 10^8$ m/s) aus; die Wellenlänge beschreibt dabei die Distanz, die innerhalb einer Schwingung zurückgelegt wurde. Bei einer Frequenz von 50 Hz (Hausstrom) liegt die Wellenlänge demnach bei 6'000 km, bei 900 MHz (Mobiltelefonie der 2. Generation, Global System for Mobile Communication GSM) bei 33 cm. Ungefähr eine Wellenlänge von der Strahlungsquelle entfernt geht das Nahfeld in das Fernfeld über.

Während es im Nahfeld keinen festen Zusammenhang zwischen elektrischem und magnetischem Feld gibt, sind im Fernfeld beide Felder aneinander gekoppelt. Dies bedeutet für die Messung elektromagnetischer Felder, dass im niederfrequenten Bereich (ca. 1 Hz bis 100 kHz) das elektrische und das magnetische Feld separat gemessen werden müssen, während im hochfrequenten Bereich (ca. 100 kHz bis 100 GHz) die Messung eines der beiden Felder in der Regel ausreicht.

Insbesondere von der Stromversorgung (50 Hz) und der Versorgung der Eisenbahn (16.7 Hz) gehen niederfrequente elektrische und magnetische Felder aus. Ein elektrisches Feld entsteht immer dann, wenn eine elektrische Installation oder ein Gerät unter Spannung steht, und es ist auch dann vorhanden, wenn kein Strom fließt. Ein magnetisches Feld hingegen resultiert, wenn Strom fließt, wenn also Stromverbraucher eingeschaltet werden.

Innerhalb des Hauses werden die niederfrequenten Felder durch Installationen und elektrische Geräte erzeugt. Direkt an der Oberfläche einiger Geräte mit Motoren (z.B.

Haarfön, Rasierapparat) können lokal hohe Feldstärkewerte auftreten. Diese Spitzen sind jedoch räumlich eng begrenzt und nehmen im Allgemeinen mit jedem Zentimeter Entfernung vom Gerät erheblich ab (www.bfs.de/elektro). Von Aussenraumquellen wie z.B. Hochspannungsleitungen ausgehende niederfrequente elektrische Felder sind im Innenraumbereich durch das Gebäude stark abgeschirmt.

Niederfrequente elektrische Felder dringen aufgrund der relativ guten Leitfähigkeit des menschlichen Körpers kaum in diesen ein, während die niederfrequenten magnetischen Felder den Körper vollständig durchdringen. Typischerweise liegt das körperinterne elektrische Feld bei ca. einem Millionstel des externen elektrischen Feldes ^[1]. Die Wirkung dieser Ströme ist bisher kaum erforscht, Forschungsschwerpunkte im niederfrequenten Bereich liegen bisher eher beim magnetischen Feld. Dies ist jedoch kritisiert worden ^[2]. Es gibt Elektrobiologen, die aus ihren praktischen Erfahrungen heraus auf mögliche gesundheitliche Wirkungen von niederfrequenten elektrischen Felder hinweisen ^[3].

Die meisten modernen Kommunikationsmittel nutzen hochfrequente EMF-Strahlung zur Übertragung von Daten. Die Sendeanlagen für Radio, Fernsehen, Mobilfunk und Satellitenkommunikation sind daher Quellen hochfrequenter elektromagnetischer Strahlung, die aus dem Aussenraum in den Innenraum dringen kann. UKW-Rundfunk sendet im Frequenzbereich zwischen 88 und 108 MHz, Mittelwelle zwischen 0.5 und 1.5 MHz, CB-Funk bei 27 MHz, GSM-Mobilfunk bei 900 bzw. 1800 MHz und UMTS bei 2 GHz (www.bfs.de/elektro). Innenraumquellen hochfrequenter Felder sind beispielsweise Schnurlostelefone (DECT; digital enhanced cordless telephones) oder andere Haushaltsgeräte wie zum Beispiel Leuchtstoffröhren, Mikrowellengeräte oder Babyphone.

3.2.5 Gesetzliche Grundlagen

Die "Verordnung über den Schutz vor nichtionisierender Strahlung (NISV)" vom 23. Dezember 1999 regelt in der Schweiz die elektrischen und magnetischen Emissionen und Immissionen ortsfester Anlagen (z.B. Mobilfunkbasisstationen, elektrische Leitungen,

Transformatorenstationen) im Bereich von 0 Hz bis 300 GHz. Dabei wurde ein zweistufiges Schutzkonzept angelegt, das in eine Stufe der Gefahrenabwehr und eine der Vorsorge unterteilt ist.

Für die Gefahrenabwehr wurden als Immissionsgrenzwerte die Referenzwerte der ICNIRP (International Commission on Non-Ionizing Radiation Protection) für die elektrische und magnetische Feldstärke übernommen ^[4], welche auch der EU-Ratsempfehlung ^[5] zugrunde liegen. Der Immissionsgrenzwert ist frequenzabhängig. Für die magnetische Flussdichte beträgt er 100 μT bei der Netzfrequenz (50 Hz) bzw. 300 μT bei der Frequenz des Bahnstroms (16.7 Hz). Für die elektrische Feldstärke beträgt er für diese beiden Frequenzen 5000 bzw. 10000 V/m ^[5, 6]. Im Hochfrequenzbereich liegt der Immissionsgrenzwert für die elektrische Feldstärke je nach Frequenzband zwischen 28 und 87 V/m.

Im Sinne der Vorsorge wurden in der NISV zusätzlich Anlagegrenzwerte festgelegt, die sich nicht auf eine biologische Begründung stützen, sondern auf die technische und betriebliche Machbarkeit und die wirtschaftliche Tragbarkeit einer weitergehenden Reduzierung der Felder. Diese Anlagegrenzwerte liegen im hochfrequenten Bereich ca. bei einem Zehntel der ICNIRP-Grenzwerte. Sie betragen für Mobilfunkbasisstationen 4-6 V/m, für Lang- und Mittelwellensender 8.5 V/m und für die übrigen Sender 3 V/m. Sie gelten jeweils nur für die Strahlung einer einzelnen Anlage und sind nur an den Orten einzuhalten, an denen sich Menschen längere Zeit aufhalten (Orte mit empfindlicher Nutzung). Für die Art, wie hochfrequente Felder von Mobilfunk-Basisstationen (GSM) im Frequenzbereich um 900 oder 1800 Hz gemessen werden sollen, hat das Bundesamt für Umwelt, Wald und Landschaft in Zusammenarbeit mit dem Bundesamt für Metrologie und Akkreditierung 2002 eine Messempfehlung herausgegeben^[7] (siehe 4.2 EMF-Messungen).

Im niederfrequenten Bereich wird im Sinne der Vorsorge die magnetische Flussdichte begrenzt. Der Anlagegrenzwert für neue Frei- und Kabelleitungen, neue Eisenbahnanlagen sowie für sämtliche Transformatorenstationen beträgt 1 μT . Für alte Frei- und Kabelleitungen

sowie alte Eisenbahnanlagen treten an die Stelle des Anlagegrenzwertes konkrete technische Massnahmen, die an den Anlagen zu treffen sind.

Baubiologische Kreise schlagen weitaus tiefere "Vorsorgewerte" für EMF vor. Diese "Vorsorgewerte" besitzen allerdings keinerlei rechtliche Bindung. Sie gehen primär von Beobachtungen und Erfahrungswerten aus und weisen eine sehr grosse Bandbreite auf. Als Beispiel des unteren Bereichs eines vorgeschlagenen Wertes schlägt der Bund für Umwelt und Naturschutz Deutschland für die niederfrequente magnetische Flussdichte einen "Vorsorgewert" von 0.01 μT , und für die elektrischen Felder von 0.5 V/m vor^[8].

Emissionen von Hausinstallationen oder elektrischen Geräten (z.B. Mikrowellenöfen, Mobiltelefone) oder auch standortfeste Geräte und Anlagen (z.B. Kochherde, Elektroheizungen) sind in der NISV ausgeschlossen^[6]. Für die Hausinstallationen gibt es in der NISV eine generelle Bestimmung, welche die anzuwendende Installationspraxis beschreibt. (Möglichst sternförmige Anlage der Installationen zur Minimierung der Belastungen).

3.2.6 Material und Methoden des umweltmedizinischen Beratungsprojektes

3.2.6.1 Projektziel und -Ablauf

Ziel des umweltmedizinischen Beratungsprojektes war es, Menschen eine ganzheitliche Beratung anbieten zu können, die ihre Gesundheitsbeschwerden auf Umweltbelastungen zurückführen. Während des Jahres 2001 wurde das Pilotprojekt an der Universität Basel in Zusammenarbeit mit verschiedenen kantonalen Fachstellen durchgeführt. Information über das Projekt wurde an die Umweltfachstellen und Ärztinnen und Ärzte der Region verschickt und ausserdem in verschiedenen Artikeln in den Medien veröffentlicht. Bewohner der Region Basel, die ihre Gesundheitsbeschwerden auf Umweltbelastungen zurückführten, konnten an dem Beratungsprojekt teilnehmen. Die Anmeldung erfolgte über eine Umweltfachstelle oder den Hausarzt, die Betroffenen konnten sich aber auch direkt an die Projektleitung wenden. Nach Kontaktaufnahme mit der Projektassistentin erhielten die an der Studie Interessierten einen Fragebogen. Im Verlauf des Projektes wurden die Studienteilnehmer allergologisch-

internistisch untersucht, in psychologischen Interviews befragt und sie füllten mehrere psychometrische Fragebögen aus. Zudem wurde jeder Studienteilnehmer von einer der kantonalen Umweltfachstellen (Kantonales Laboratorium Basel-Stadt, Amt für Umwelt und Energie, Basel-Landschaft) zu Hause besucht, um mögliche Quellen von biologischen oder chemischen Umweltbelastungen im Wohnbereich erfassen zu können. Bei 25 Fällen wurden die EMF-Belastungen von einem weiteren Fachmann gemessen. In einer Fallkonferenz diskutierten die beteiligten Fachstellen und Ärzt/innen die Ergebnisse der einzelnen Untersuchungen und bewerteten nach einem einheitlichen Verfahren, wie plausibel die angegebenen Beschwerden medizinisch, psychologisch oder durch Umweltfaktoren erklärt werden können. Abschliessend fand ein Beratungsgespräch im Kantonsspital Basel statt, bei dem das weitere Vorgehen mit den Teilnehmer/innen besprochen und Massnahmen für die Verbesserung der Situation empfohlen wurden. Einige Monate nach dem Beratungsgespräch wurde von einer unabhängigen Person ein telefonisches Nachgespräch durchgeführt, in dem die Teilnehmer/innen ihren Eindruck zum Projekt schildern konnten. Von besonderem Interesse war dabei die Frage, ob es ihnen gesundheitlich besser ginge oder nicht.

3.2.6.2 EMF-Messungen

Die EMF-Messungen umfassten niederfrequente (NF) elektrische und magnetische Felder im Frequenzbereich von 5 Hz bis 50 kHz, und hochfrequente Felder (HF) in einem Frequenzbereich von 0.1 bis 3 GHz (breitbandige Messung); statische Felder oder ionisierende Strahlung wurden in diesem Projekt nicht gemessen.

Das Bundesamt für Umwelt, Wald und Landschaft hat in Zusammenarbeit mit dem Bundesamt für Metrologie und Akkreditierung für die von GSM-Basisstationen ausgehenden hochfrequenten Felder eine Messempfehlung herausgegeben ^[7]. Obwohl diese Empfehlung erst nach Abschluss der Messungen für das Projekt herausgekommen ist, soll auf einige Punkte kurz eingegangen werden, da diese Empfehlung den Rahmen für eine "gute Messung" absteckt.

Da die Strahlungsbelastung in Innenräumen erheblich schwankt, wurde in der Empfehlung festgehalten, dass für die Erfassung einer NIS-Belastung der "örtlich höchste Wert (...), der an einem gegebenen Ort mit empfindlicher Nutzung auftritt, zugrunde gelegt" werden sollte ^[7]. Für die Beurteilung der Belastung soll dabei der abgelesene Wert (als der wahrscheinlichste Wert der Belastung) genommen werden und die Messunsicherheit nicht mit einberechnet werden. Weiterhin soll dieser abgelesene Wert in den sogenannten "Beurteilungswert" umgerechnet werden. Dies ist der Wert den man als örtliches Maximum messen würde, wenn die Anlage auf Vollast laufen würde. Bei "Orten mit empfindlicher Nutzung" handelt es sich laut Messempfehlung ausdrücklich häufig um Innenräume, in denen bei offenem Fenster zu messen ist, vorausgesetzt, die Fenster lassen sich öffnen.

Während die Messvorschriften in Verbindung mit der NIS-Verordnung zum Ziel haben, systematisch festzustellen ob Grenzwerte eingehalten werden, ergeben sich für das Projekt inhaltliche Abweichungen. Im Projekt ging es für die weitere Beurteilung dieser Belastung in Bezug auf die gesundheitlichen Beschwerden eher um eine "persönlich relevante Belastung", also eine Belastung, der die Betroffenen auch tatsächlich ausgesetzt waren. Für dieses Projekt wurde also, wie auch in der Messempfehlung festgelegt, der jeweils örtlich höchste Wert der Belastung in einem Raum erfasst. Es erfolgte jedoch keine Hochrechnung auf Vollast der Anlage. Um für die Projektteilnehmer/innen einen Ratschlag zur Verbesserung ihrer gesundheitlichen Situation zu erarbeiten, war es wichtig, festzustellen, in welchen Räumen sie sich gewohnheitsmässig am häufigsten und am längsten aufhielten und welche EMF-Belastung dort vorlag.

Alle angegebenen Nachweisgrenzen für die im Projekt benutzten Geräte entsprechen dem jeweils untersten Bereich, für den das Messgerät kalibriert ist.

Niederfrequente Felder

Gerät niederfrequente elektrische Felder

Für die Aufzeichnungen des E-Feldes in Innenräumen im Frequenzbereich von 5 Hz bis 400 kHz wurde das EM-400/E-Mess-System von „Symann Trebbau“ mit dreidimensionaler isotroper E-Feld-Messsonde (Kugelsonde) benutzt. Der Messfehler beträgt +/- 3 % bis +/- 5 % vom Messwert. Die Auflösung liegt bei 0.1 % vom Messbereich (hier im Normalfall 0.2 V/m), die untere Nachweisgrenze liegt bei 3 V/m. Das Gerät ist kalibriert und CE-zertifiziert und führt minütlich anhand der eingespeicherten Grunddaten eine Eigenkalibration durch.

Als Zusatz wurde in einigen Fällen die so genannte kapazitive Ankopplungsspannung (U_{kap}) gemessen. Die kapazitive Ankopplungsspannung ist die Potentialdifferenz gegenüber Erde, auf die sich eine Person in einem elektrischen Wechselfeld infolge kapazitiver Kopplung auflädt. Die Messung dieser Spannung ist allerdings fehleranfällig. Im vorliegenden Kontext dienen Messwerte der kapazitiven Ankopplungsspannung lediglich als qualitatives Indiz für das Vorhandensein eines niederfrequenten elektrischen Feldes, - nicht als quantitatives Belastungsmass. Eingesetzt wurde für diese Messungen das Voltkraft GS-6520-Multimeter-Gerät mit einem 10-Mega- Ω -Innenwiderstand.

Gerät niederfrequente magnetische Felder (H-Feld NF)

Die Magnetfeldmessungen im Frequenzbereich von 5 Hz bis 50 kHz wurden mit dem selben Gerät wie für die elektrischen Felder durchgeführt, jedoch mit einer anderen Sonde: einer dreidimensionalen, isotropen Magnetfeld-Messsonde mit Frequenz-Filter. Der Messfehler beträgt bei 23° C +/- 3 %, ausserhalb davon zwischen 0° bis 40° +/- 5 % vom Messwert. Die untere Nachweisgrenze der niederfrequenten magnetischen Flussdichte liegt bei 0.02 μT , die Auflösung beträgt 0.1 % des Messbereiches, also hier im Normalfall 0.01 oder 0.001 μT .

Bei einer Langzeitmessung von niederfrequenten Magnetfeldern, wie sie in dem Projekt in zwei Fällen durchgeführt wurde, wird manuell ein Zeittrigger eingestellt (hier 21 bzw. 23 Sekunden). Die dargestellten Werte entsprechen dann einem Mittelwert über dieses Messintervall.

Messvorgang niederfrequente Felder

Die Messungen wurden in zwei Schritten durchgeführt. Zunächst wurde die Sonde ca. in der Mitte des Raumes, 1 m über dem Boden aufgestellt. Durch eine orientierende Messung mit Frequenzanalyse konnte festgestellt werden, welche Quellen in dem Raum vorhanden waren. In einem nächsten Schritt wurde zusätzlich an Punkten gemessen, die auf einer sogenannten "Gebrauchshöhe" lagen, also der wahrscheinlichen Exposition eines Körpers an einer bestimmten Stelle am nächsten kamen. Dazu zählte insbesondere ein Abstand von ca. 50 cm zum Schreibtisch (in etwa Position Rumpf im Sitzen) und das Bett. Beim Bett wurde auf der Mittelachse auf Kopfhöhe gemessen, sowie zur Kontrolle auf Höhe der Füße und der Mitte des Bettes. Dabei wurde mit der niederfrequenten E-Feld-Sonde ein Abstand von ca. 10 cm zum Bett eingehalten, das Magnetfeld-Messgerät wurde direkt auf dem Bett platziert. Diese Messungen waren Momentaufnahmen (Zeitdauer: einige Sekunden).

Um einzelne Quellen und ihren Beitrag an die Gesamtbelastung erkennen zu können, wurden Elektroinstallationen und Verbraucher systematisch aus- und eingeschaltet. Die in den Tabellen 2 bis 4 aufgeführten Messungen entsprachen der typischen Nutzungsart elektrischer Geräte am jeweiligen Messort: An einem Schlafplatz beispielsweise mit ausgeschalteten Lampen, an einem Computerarbeitsplatz mit eingeschaltetem Computer.

Im Fall der Messung der kapazitiven Ankopplungsspannung hält eine Testperson die Messsonde, die mit dem Messgerät verbunden ist, in der Hand. Das Messgerät selbst wird über die Schutzterde einer Steckdose geerdet.

Hochfrequente EMF

Gerät HF

Im Projekt eingesetzt wurde das PMM 8053, ein isotropes Breitbandmessgerät des EMC-Center Milano. Das Gerät ist vorkalibriert und führt eine Kalibration anhand der eingespeicherten Werte beim Einschalten sowie beim Wechseln der Sonde durch. Es macht eine Breitbandmessung der HF-Strahlung im Messbereich von 0.1 MHz bis 3 GHz, d.h. es werden sowohl Radio- und Funkemissionen als auch Mobilfunkstrahlungen erfasst. Um den Beitrag des Mobilfunks an der hochfrequenten Strahlung besser abschätzen zu können, wurde anschliessend mit einer zweiten Sonde mit engerem Frequenzbereich (0.7 bis 3 GHz) gemessen. Die Nachweisgrenze liegt bei 0.3 V/m.

Messvorgang HF

Mit der Breitbandsonde wurde zunächst der Raum im Abstand von ca. $\frac{1}{2}$ m von den Wänden und Fenstern abgesprochen. Über einen Zeitraum von ungefähr fünf Minuten wurde eine Fläche parallel zur Fensterwand "abgetastet" und der höchste Wert über ca. 10 bis 20 Sekunden erfasst. Geringfügige zeitliche Schwankungen der Anzeige wurden ausgemittelt (z.B. Schwankungen von 0.63 bis 0.65 V/m wurden als 0.64 V/m notiert).

Wie für die niederfrequenten Felder wurden in einem zweiten Schritt Messungen an ausgewählten Punkten auf der für die jeweilige Nutzung typischen Gebrauchshöhe durchgeführt. Bei Messungen auf dem Bett wurde auch hier ein Abstand der Sonde von ca. 10 cm eingehalten.

3.2.6.3 Potenziell relevante EMF-Exposition

Als "potenziell relevante persönliche Belastung" wurden Expositionen erachtet, die zwei Bedingungen erfüllten: Erstens musste eine Mindeststärke der Exposition vorhanden sein.

Ausserdem musste die Exposition an einer Stelle erfolgen, an der sich die betreffende Person während mehreren Stunden pro Tag aufhielt.

Als Mindestexposition für niederfrequente Magnetfelder wurde ein Zehntel der schweizerischen Anlagegrenzwerte (0.1 μ T) definiert. Für die niederfrequenten elektrischen Felder wurde ein Schwellenwert von 10 V/m festgelegt; diese beiden Werte für niederfrequente Felder sind auch von Elektrobiologen vorgeschlagen worden [3, 9]. Für die hochfrequenten Felder wurde ein Wert von 0.6 V/m gewählt. Dies entspricht dem "Salzburger Vorsorgewert" [10] in seiner ursprünglichen Fassung und gleichzeitig dem von den Ärztinnen und Ärzten für den Umweltschutz in der Schweiz vorgeschlagenen Grenzwert [11].

Diese Werte sind ausdrücklich nicht als Grenzwerte zu verstehen, sondern stellen einen aus den Erfahrungen von Elektrobiologen abgeleiteten Schwellenwert dar, der jedoch wissenschaftlich nicht begründet werden kann. Wichtig ist hier, dass ein überschrittener Schwellenwert nicht allein ausschlaggebend für die Plausibilitätsbeurteilung der gesundheitlichen Beschwerden durch das interdisziplinäre Team war (siehe "Vorgang der Symptombewertungen"), sondern lediglich eine von mehreren zu erfüllenden Voraussetzungen. Ein unterschrittener Schwellenwert jedoch führte zu einer "unplausiblen" Beurteilung.

3.2.6.4 Plausibilitätsbeurteilung

Die meisten der Betroffenen berichteten über mehr als ein Symptom und viele vermuteten verschiedene Ursachen für ihre Symptome. Daher wurde jedes einzelne Symptom in der Fallkonferenz separat besprochen. Die Ergebnisse der medizinischen, psychologischen sowie der Umwelt-Untersuchung wurden dargelegt und diskutiert. Es wurde eine "Plausibilitätsbeurteilung" durchgeführt, bei der beurteilt wurde, ob die Existenz eines Symptoms aus den jeweiligen Befunden heraus erklärbar war.

Die medizinische Plausibilität eines Symptoms wurde aus der Krankengeschichte und den medizinischen Befunden abgeleitet. Die Plausibilitätsbeurteilung aus psychiatrischer

Perspektive erfolgte aufgrund der psychiatrischen und psychodynamischen Untersuchung, der wissenschaftlichen Erkenntnisse über Symptome bei psychiatrischen Erkrankungen und auf der Diagnose psychosozialen Stresses bei Beginn der Symptome.

Die Umweltplausibilität basierte auf der vorhandenen Literatur zu den jeweiligen Expositionen (auch im Fall, wenn kein toxikologisch relevanter Wert erreicht oder überschritten wurde). Für eine EMF-Plausibilität war von Bedeutung, ob neben nachweisbaren Feldern und dem Aufenthalt der betroffenen Personen im Bereich der Felder auch ein zeitlicher und ein räumlicher Bezug zwischen der Belastung und dem Auftreten der Beschwerden gegeben war. Wichtigstes Kriterium war hierbei, dass sich das Symptom erst nach Auftreten der Belastung entwickelt hatte (zeitlicher Bezug). Falls die Betroffenen bereits einmal versucht hatten, die Exposition zu reduzieren, war von Interesse, in welcher Form dies stattgefunden hatte und wie sich das Befinden der Betroffenen änderte, wenn sie den Feldern nicht ausgesetzt waren (z.B. Ferien, Sicherung herausdrehen, schlafen in einem anderen Raum, etc.).

Jedes Symptom der Betroffenen wurde in der Fallkonferenz jeweils aufgrund der vorliegenden Befunde für jeden der drei Bereiche (Medizin, Psychologie-Psychiatrie, Umwelt) auf einer fünfstufigen Plausibilitätsskala (von "1 = unplausibel" bis zu "5 = sehr plausibel") eingeordnet. In einem zweiten Schritt wurde diese fünfstufige Skala dichotomisiert, indem die Plausibilitätsgrade "1" und "2" als "unplausibel", und "3" bis "5" als "plausibel" zusammengefasst wurden. Im Konsensrating wurde anschliessend beurteilt ob mindestens eine der von den Teilnehmer/innen vorgeschlagenen Umweltätiologien plausibel war.

Jedem Symptom wurden gleichzeitig drei Plausibilitätsbewertungen zugeordnet, je eine aus den drei Untersuchungsbereichen. Dies hat zur Folge, dass auch "multiple Plausibilitäten" auftreten konnten, d.h. dass das selbe Symptom gleichzeitig von zwei oder drei Fachgebieten als "plausibel erklärbar" bewertet werden konnte.

3.2.7 Falldarstellungen

Der originale Report an das Bundesamt für Umwelt, Wald und Landschaft enthält an dieser Stelle 13 Fallbeschreibungen, die den restlichen Berichtstext beispielhaft erläutern. Für eine breitere Öffentlichkeit sind diese Fallbeispiele nicht gedacht und daher aus Anonymitätsgründen aus dem hier eingefügten Berichtstext entfernt.

Die 13 Personen, von denen hier eine Fallbeschreibung gegeben wurde, unterscheiden sich von den 12, von denen dies nicht getan wurde nur in geringem Mass: Die Teilnehmer/innen der beschriebenen Fälle sind im Schnitt ca. 2 Jahre älter. Die mittlere Anzahl der geschilderten Beschwerden ist praktisch identisch (3.3 bzw. 3.5), ebenso die Anzahl Personen mit mindestens einer psychiatrische Diagnose (77 bzw. 75 %). Bei den Personen, die nicht beschrieben wurden, wurden etwas mehr medizinische (3.2 zu 2.5) und psychologisch-psychiatrische Diagnosen (1.6 zu 1.1) gestellt. Keiner dieser Unterschiede ist jedoch statistisch signifikant.

3.2.8 Ergebnisse

3.2.8.1 Charakteristika der Projektteilnehmer/innen

Insgesamt interessierten sich 95 Personen für das Projekt, 63 nahmen an allen Untersuchungen teil. Davon führten 25 ihre Beschwerden auf elektromagnetische Felder zurück. Von den 63 Projektteilnehmer/innen kamen 24 (38 %) über eine Umweltfachstelle, 22 (35 %) über Zeitungen oder Zeitschriftenartikel, 12 (19 %) über Ärztinnen oder Ärzte und 5 (8 %) über andere Wege zum Projekt. Von den Personen, die EMF als Ursache, oder Mit-Ursache ihrer Beschwerden vermuteten, kamen 14 (56 %) über die Umweltfachstellen, sechs (24 %) über die Medien, zwei (8%) über Ärztinnen oder Ärzte und drei (12%) über andere Eingänge zum Projekt.

Die Projektteilnehmer/innen, die EMF als Ursache ihrer Beschwerden vermuteten, waren geringfügig jünger als diejenigen, die andere Umweltursachen annahmen (Durchschnitt 51 vs. 57Jahre). In Bezug auf das Geschlechterverhältnis gab es keinen Unterschied. Während es in Bezug auf den Bildungsstand kaum einen Gruppenunterschied gab, hatten sich signifikant weniger Personen aus der EMF-Gruppe vor Projektbeginn von ihrem Hausarzt oder in einer Klinik beraten lassen. Bei der Inanspruchnahme alternativmedizinischer Angebote war es tendenziell umgekehrt (siehe Tabelle 1).

	EMF Projekt- teilnehmer/innen (n=25)	nicht-EMF Projekt- teilnehmer/innen (n=38)	p-Wert
Alter (Median)	52	57.5	0.2
%-Anteil Frauen	56.0%	60.3%	0.6
Tiefer oder mittlerer Bildungsstand	44%	47.2%	0.8
Hoher Bildungsstand	56%	52.8%	
War vorher bei Arzt/ Ärztin	52%	81.1%	0.02
War vorher bei "Alternativmed".	64%	57.9%	0.6

Tabelle 1: Charakteristika der Projektteilnehmer/innen, die EMF als Ursache der Beschwerden vermuten und derjenigen, die andere Ursachen vermuten. p-Werte: Mann-Whitney, bzw. χ^2 Tests.

Obwohl Schlafstörungen in beiden Gruppen die am häufigsten genannte Beschwerde war, wurde sie von der EMF-Gruppe signifikant häufiger aufgeführt (56% vs. 26%, $p=0.02$). Die nächsthäufigsten Beschwerden waren in der Nicht-EMF-Gruppe Husten und andere respiratorische Beschwerden, während die EMF-Gruppe Kopfschmerzen, Müdigkeit oder Hautprobleme (Kribbeln, Juckreiz) auflistete.

13 von 25 (52 %) Personen aus der EMF-Gruppe vermuteten Strahlung von "Mobilfunkantennen" (EMF HF) als Ursache der gesundheitlichen Beschwerden. Fünf Personen (20 %) vermuteten das Problem ausgehend von den "elektrischen Leitungen", "Geräten wie dem PC", "Kochherd" oder "Heizungen" oder "Transformatorstationen" und "Oberleitungen" (EMF NF), sieben (28 %) vermuteten beides oder grenzten ihren Verdacht nicht näher ein ("Elektrosmog").

Zwölf Personen (48 %) verdächtigten lediglich EMF, die anderen 13 Teilnehmer/innen (52 %) vermuteten zusätzlich Innen- oder Aussenraumluftverschmutzungen, Schimmel, Lärm, trockene Luft, Emissionen aus dem Mobiliar oder Teppich, Wasseradern, verschmutztes Trinkwasser oder Formaldehyd als weitere Belastungsquellen.

Passend zu den vermehrt berichteten respiratorischen Symptomen in der Nicht-EMF-Gruppe wurde hier signifikant häufiger Asthma diagnostiziert (ICD 10 Code J 45^[12], $p = 0.02$).

In beiden Gruppen wurden psychiatrische Diagnosen häufig gestellt und waren wesentlich häufiger als normalerweise in der Allgemeinbevölkerung^[13]. Eine Studie in Deutschland fand im Vergleich eine Lebenszeitprävalenz psychischer Störungen von 30.3 % (ohne Störungen durch Substanzkonsum)^[14]. Das Kriterium "mindestens eine vorhandene psychiatrische Haupt-Diagnose" traf auf ca. $\frac{3}{4}$ der EMF-Gruppe zu, im Vergleich zu ca. $\frac{2}{3}$ der Nicht-EMF-Gruppe. Dieser Unterschied zwischen den beiden Gruppen ist jedoch nicht statistisch signifikant ($p = 0.2$). Weder Depressionen, Angststörungen, Persönlichkeitsstörungen noch Somatisierungsstörungen waren in der EMF-Gruppe signifikant häufiger als in der Nicht-EMF-Gruppe (jeweils $p = 0.5, 0.6, 0.6, 0.4$).

3.2.8.2 Expositionssituation in der EMF-Gruppe

Innerhalb der EMF-Gruppe von 25 Personen waren drei Paare verheiratet und lebten zusammen, so dass Messungen an 22 verschiedenen Orten durchgeführt werden konnten. Eine dieser Messungen wurde an einem Arbeitsplatz durchgeführt, so dass insgesamt für 21 verschiedene Wohnbereiche Werte vorliegen.

Es wurde in 83 Räumen EMF gemessen, was im Durchschnitt 3 - 4 Räumen pro Teilnehmer/in entspricht. Diese beinhalteten 21 Schlafzimmer, 21 Wohnzimmer, 14 Büros oder Geschäftsräume, 7 Küchen, 8 Kinderzimmer, sowie verschiedene Gäste-, Musik- oder sonstige Zimmer und Gartensitzplätze. In einer zusätzlichen (Arbeitsplatz-)Küche wurden lediglich hochfrequente Felder gemessen.

In den folgenden drei Tabellen zum niederfrequenten elektrischen (Tabelle 2) und magnetischen (Tabelle 3), sowie dem hochfrequenten Feld (Tabelle 4) finden sich folgende statistische Angaben :

- 1. Spalte: Die Art des Zimmers, in denen gemessen wurde, wobei hier nur die am häufigsten untersuchten Räume Schlafzimmer, Wohnzimmer, Büros und Küchen berücksichtigt sind.
- 2. Spalte: Die Anzahl Zimmer, in denen gemessen wurde.
- 3. Spalte: die Anzahl der Zimmer, in denen ein EMF oberhalb der Nachweisgrenze des Messgerätes erfasst wurde, wobei der übliche Nutzungszustand vorlag (z.B. Bett: ausgeschaltete Nachttischlampe, Computerarbeitsplatz: eingeschalteter Computer).
- 4. Spalte: Die Anzahl der Zimmer, in denen ein EMF oberhalb des baubiologischen Schwellenwertes erfasst wurde, bei üblicher Nutzung.
- 5. bis 7. Spalte: 5 Perzentil, Median und 95. Perzentil der Messungen bei üblicher Nutzung.
- 8. Spalte: Anzahl Zimmer, in denen Felder oberhalb der Nachweisgrenze auftraten, bei Nutzung mit eingeschalteten Geräten (z.B. Einsatz einer Dunstabzugshaube in der Küche).

- 9. Spalte: Gemessene Maximalwerte, die auch kurzfristigen Geräteeinsatz beinhalteten.

3.2.8.3 Niederfrequentes elektrisches Feld

	Anzahl gemessene Zimmer	Übliche Nutzung					Nutzung mit eingeschalteten Geräten	
		Anzahl Zimmer mit E>3 V/m	Anzahl Zimmer mit E>10 V/m	Elektrische Feldstärke (V/m)			Anzahl Zimmer mit E>3 V/m	Elektrische Feldstärke, Maximalwert (V/m)
				5. Perzentil	Median	95. Perzentil		
Schlafzimmer	21	19	14	< 3	23	90	20	110
Wohnzimmer	21	17	10	< 3	9	46.5	18	90
Büro/Praxis	14	13	9	< 3	11	82.5	13	160
Küche	7	7	3	4	6.5	200	7	200

Tabelle 2: Übersicht über die gemessenen E-Felder, Erläuterungen siehe Abschnitt Fehler! Verweisquelle konnte nicht gefunden werden.

Niederfrequente elektrische Felder sind fast ubiquitär und konnten in 89% aller Zimmer, in 19 der 21 Schlafzimmer (90%), 17 der 21 Wohnzimmer (81%), 13 von 14 Büros bzw. Praxisräumen (93%) und allen Küchen festgestellt werden. Felder, die nur sehr kurzfristig durch den Einsatz von abschaltbaren Geräten entstanden, wurden hier nicht mit einbezogen. Beispielsweise entstanden in dem Schlafzimmer eines Probanden elektrische Felder nur bei Einschalten einer Lampe, ansonsten eliminierte ein eingebauter Netzfreischalter die EMF. Messwerte oberhalb des baubiologischen Schwellenwertes von 10 V/m lagen in 14 Schlafräumen (67 %), zehn Wohnzimmern (48 %), neun Büros oder Praxisräumen (64 %) und drei (43 %) Küchen vor. Bei 23 der 25 Personen (92 %) war in mindestens einem der vier Räume ein elektrisches Feld oberhalb von 3 V/m messbar, bei 19 von 25 (76 %) Personen lagen die Felder oberhalb des baubiologischen Schwellenwertes von 10 V/m.

3.2.8.4 Niederfrequentes magnetisches Feld

	Anzahl gemessene Zimmer	Übliche Nutzung					Nutzung mit eingeschalteten Geräten	
		Anzahl Zimmer mit $B > 0.02 \mu\text{T}$	Anzahl Zimmer mit $B > 0.1 \mu\text{T}$	Magnetische Flussdichte (μT)			Anzahl Zimmer mit $B > 0.02 \mu\text{T}$	Magnet. Flussdichte, Maximalwert (μT)
				5. Perzentil	Median	95. Perzentil		
Schlafzimmer	21	11	5	< 0.02	0.04	1.15	11	1.5
Wohnzimmer	21	8	3	< 0.02	< 0.02	0.3	8	1.45
Büro/Praxis	14	9	4	< 0.02	0.045	2.03	9	15
Küche	7	3	0	< 0.02	< 0.02	0.09	5	7

Tabelle 3: Übersicht über die gemessenen B-Felder, Erläuterungen siehe Abschnitt Fehler!
Verweisquelle konnte nicht gefunden werden.

Fünf Schlafzimmer (23%), drei Wohnzimmer (14%) und vier Büros (29%) lagen über dem baubiologischen Schwellenwert von $0.1 \mu\text{T}$, jedoch keine Küche. 16 von 25 (64%) Personen hatten in mindestens einem der vier Räume messbare niederfrequente magnetische Felder oberhalb von $0.02 \mu\text{T}$. Bei 14 (56%) dieser Personen lag der Wert oberhalb von $0.1 \mu\text{T}$.

Werte oberhalb des in der NISV festgehaltenen Anlagegrenzwertes von $1 \mu\text{T}$ traten bei drei Personen auf. Da jedoch alle diese Felder durch Hausinstallationen oder elektrische Geräte (z.B. ein Halogenlampen-Trafo, eine Dunstabzugshaube) emittiert wurden, greift hier nicht die NISV (siehe Kapitel 3. "Gesetzliche Grundlagen"). Somit sind die Grenzwerte nicht überschritten. Ein Maximalwert von $15 \mu\text{T}$ ergab sich durch den Gebrauch von Trockenhauben einer Coiffeurin bei der Arbeit.

3.2.8.5 Hochfrequentes Feld

	Anzahl gemessene Zimmer	Übliche Nutzung					Nutzung mit eingeschalteten Geräten	
		Anzahl Zimmer mit HF >0.3 V/m	Anzahl Zimmer mit HF >0.6 V/m	Feldstärke HF (V/m)			Anzahl Zimmer mit HF >0.3 V/m	Feldstärke HF, Maximalwert (V/m)
				5. Perzentil	Median	95. Perz.		
Schlafzimmer	21	6	3	< 0.3	< 0.3	2.12	7	2.25
Wohnzimmer	21	5	4	< 0.3	< 0.3	1.12	6	1.35
Büro/Praxis	14	7	1	< 0.3	0.34	1.65	7	9
Küche	8	2	2	< 0.3	< 0.3	1.13	2	2.95

Tabelle 4: Übersicht über die gemessenen B-Felder, Erläuterungen siehe Abschnitt Fehler!
Verweisquelle konnte nicht gefunden werden.

In sechs Schlafzimmern (32%), fünf Wohnzimmern (24%), sieben Büros (50%) und zwei Küchen (22%) bei insgesamt 12 von 25 Personen (48%) wurden Felder oberhalb von 0.3 V/m gemessen. Drei Schlafzimmer (14%), vier Wohnzimmer (19%), ein Büro (7%) und zwei Küchen (22%) von acht (32%) Personen lagen bei den Messungen oberhalb des baubiologischen Schwellenwertes von 0.6 V/m. Keine der Belastungen erreichte den Anlagegrenzwert.

Die kurzzeitige Maximalbelastung durch ein eingeschaltetes Gerät in der Grössenordnung von 9 V/m wurde von einem Drucker abgestrahlt.

3.2.8.6 Symptomplausibilitäten in der EMF-Gruppe

Die 25 Personen schilderten insgesamt 85 verschiedene Symptome (Durchschnitt 3.4 pro Person). In der interdisziplinären Fallkonferenz wurden 15 Symptome als plausibel mit der Umweltbelastung zusammenhängend beurteilt, davon folgende 14 Symptome von acht Personen als plausibel mit der EMF-Belastung zusammenhängend:

- Schlafstörungen (5),
- Müdigkeit oder Erschöpfung (2),
- Kopfschmerzen (2),
- Unruhe oder Nervosität (2),
- Kribbeln (1),
- Herzklopfen (1),
- Gefühl von Druck und Hitze im Kopf (1)

Eine Person hatte ein Symptom, das plausibel einer anderen Umweltbelastung (Schimmel) zugeordnet wurde. Insgesamt 71 Symptome wurden vom Projektteam als "nicht plausibel" mit einer EMF-Belastungen zusammenhängend beurteilt. Wie in Tabelle 5 dargestellt, konnten 60 Symptome plausibel entweder durch medizinische, oder psychologische/psychiatrische oder Umweltfaktoren allein erklärt werden, wovon 6 Symptome allein durch EMF. 17 Symptome hatten "multiple Plausibilitäten". Das heisst, Befunde aus verschiedenen Bereichen konnten gleichzeitig das Symptom plausibel erklären

	<i>EMF-Gruppe</i>		<i>Nicht-EMF-Gruppe</i>	
	Anzahl Symptome	%	Anzahl Symptome	%
Summe	85	100 %	117	100 %
nur"einfache" Plausibilität	60	70.6 %	58	49.6 %
medizinisch	6	7.1 %	11	9.4 %
Psychologisch-psychiatrisch	48	56.4 %	44	37.6 %
Umwelt	6	7.1 %	3	2.6 %
Multiple Plausibilität	17	20 %	40	28.2 %
Medizinisch und Umwelt	4	4.7 %	17	14.5 %
medizinisch und psych.-p.	8	9.4 %	9	7.7 %
Psych.-p. und umwelt	5	5.9 %	7	6.0 %
Med. und psych.-p. und Umw..	0	0 %	7	6.0 %
Keine Plausibilität	8	9.4 %	19	16.2 %
Alle unplausibel	5	5.9 %	9	7.7 %
Kein Rating möglich	3	3.5 %	10	8.5 %

Tabelle 5: Medizinische, psychologisch-psychiatrische und Umwelt-Plausibilität der berichteten Symptome. Bei der EMF-Gruppe ist der plausible Umweltfaktor mit einer Ausnahme die EMF-Belastung.

3.2.8.7 EMF-Expositionen

Die folgenden drei Abbildungen zeigen jeweils für alle Projektteilnehmer/innen ("A" bis "Y") die gemessenen Werte der niederfrequenten elektrischen Feldstärke, der magnetischen Flussdichte, sowie der hochfrequenten Felder. Expositionen, die mit Symptomen als plausibel zusammenhängend bewertet wurden, sind rot eingefärbt.

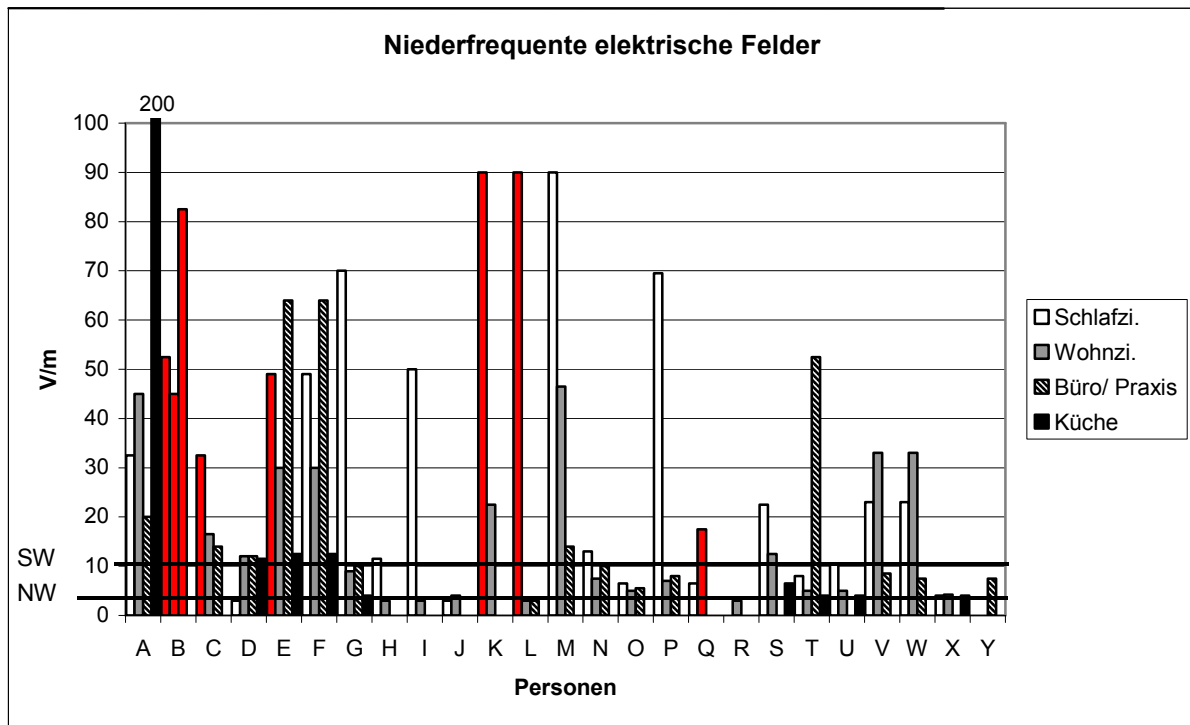


Abbildung 1: Niederfrequente elektrische Felder bei üblicher Nutzung, nach Personen und Räumen geordnet. Für Werte unterhalb der Nachweisgrenze (NW) von 3 V/m wurde 3 V/m eingesetzt. Expositionen, die als plausible Erklärung für ein Symptom beurteilt wurden, sind rot eingefärbt. "SW" markiert den im Projekt benutzten "Schwellenwert" von 10 V/m.

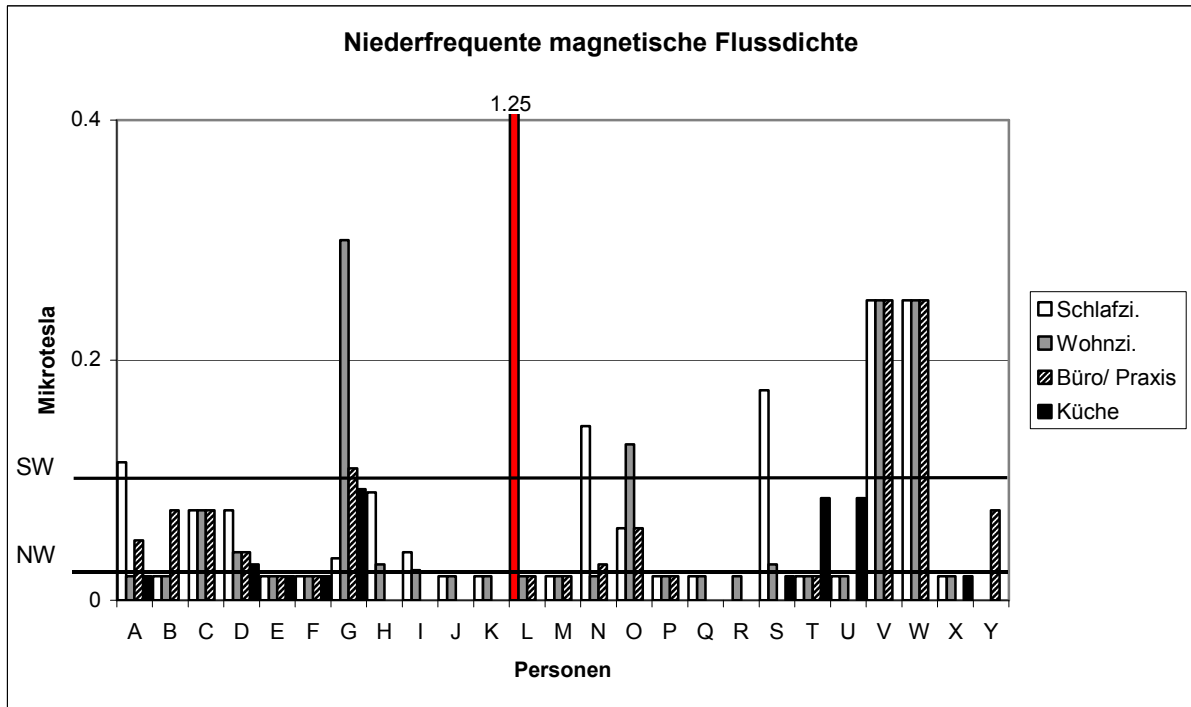


Abbildung 2: Niederfrequente magnetische Flussdichte, Gebrauchszustand, nach Personen und Räumen geordnet, Personen mit 'plausiblen' Symptomen aufgrund der jeweiligen Exposition in rot eingefärbt, bei Personen mit Feldern unterhalb der Nachweisgrenze (NW) wurde 0.02 Mikrotesla eingesetzt. "SW" markiert den im Projekt verwendeten "Schwellenwert" von 0.1 Mikrotesla.

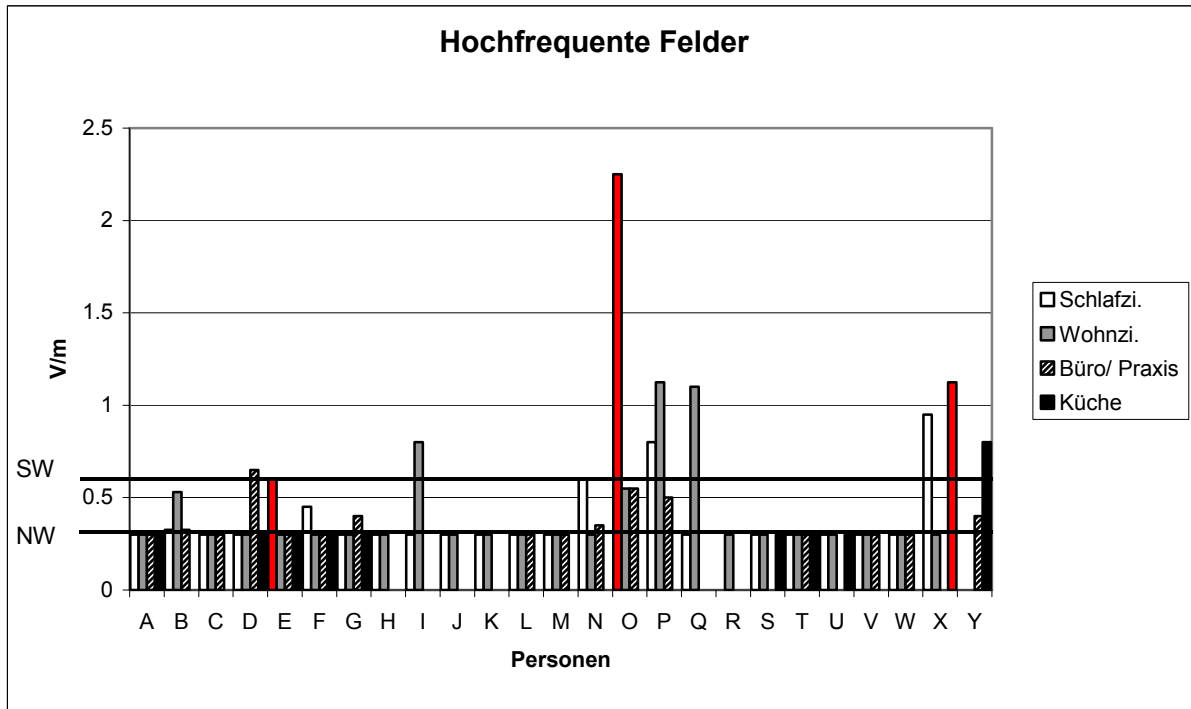


Abbildung 3: Hochfrequente Felder, übliche Nutzung, nach Personen und Räumen geordnet, Personen mit 'plausiblen' Symptomen aufgrund der jeweiligen Exposition in rot eingefärbt, bei Personen mit Feldern unterhalb der Nachweisgrenze (NW) wurde 0.3 V/m eingesetzt. "SW" markiert den im Projekt verwendeten "Schwellenwert" von 0.6 V/m.

3.2.8.8 Beratungsvorschläge

Die abgegebenen Beratungsvorschläge waren auf die jeweilige Situation der Betroffenen zugeschnitten und umfassten häufig gleichzeitig Ratschläge von verschiedenen Seiten. Als einfaches Beispiel konnte eine Beratung von der Umweltseite beinhalten, nachts die Sicherungen herauszudrehen oder einen Netzfreischalter einbauen zu lassen, von der medizinischen Seite, einen Spezialisten für eine weitere Abklärung zu konsultieren und von der psychischen Seite eine Entspannungstechnik (wie zum Beispiel autogenes Training) zu erlernen.

3.2.9 Evaluation des Projektes aus Sicht der Teilnehmer/innen

20 der 25 Personen (80 %) aus der EMF-Gruppe und 34 von 38 Personen (89 %) aus der Nicht-EMF-Gruppe konnten für die Projektevaluation interviewt werden. Von den Befragten aus der EMF-Gruppe berichteten 10 Personen (50 %), dass sich der Gesundheitszustand gebessert hätte, in der Nicht-EMF-Gruppe waren dies zwölf Personen (35 %) (siehe Tabelle 6). Die Erfolgsquote des Projekts (gebesserter Gesundheitszustand) ist somit in der EMF-Gruppe tendenziell höher als in der Nicht-EMF-Gruppe, wenn auch statistisch nicht signifikant ($p = 0.3$). Die Misserfolgsquote (Verschlechterung des Gesundheitszustandes) ist generell niedrig und unterscheidet sich zwischen den beiden Gruppen nicht signifikant. In beiden Gruppen berichten ungefähr die Hälfte der Teilnehmenden über einen unveränderten Gesundheitszustand.

Gesundheitszustand zum Zeitpunkt des Evaluationsinterviews im Vergleich zum Beginn der Projektteilnahme	EMF-Gruppe,	Nicht-EMF-Gruppe,
	20 (100%)	34 (100 %)
besser	10 (50 %)	12 (35 %)
Gleich	9 (45 %)	17 (50 %)
schlechter	1 (5 %)	5 (15 %)

Tabelle 6: Gesundheitszustand ca. ein halbes Jahr nach Projektabschluss im Vergleich zum Zeitpunkt vor Projektteilnahme

Weiterhin wurden alle Teilnehmer in dem Gespräch gefragt, ob sie Massnahmenvorschläge umgesetzt hatten und welches die Auswirkungen waren (Tabelle 7). Von der EMF-Gruppe hatten 85% Massnahmen umgesetzt, von der Nicht-EMF-Gruppe 70%. (Unterschied nicht statistisch signifikant, $p = 0.3$). In beiden Gruppen führte die Umsetzung der Massnahme in ungefähr der Hälfte der Fälle zu einer mindestens teilweisen Besserung des Gesundheitszustandes (EMF-Gruppe: 9 von 17; Nicht-EMF-Gruppe: 12 von 24), bei der anderen Hälfte blieb ein Erfolg aus. Bezogen auf die ganze Gruppe (einschliesslich

derjenigen Personen, die keine Massnahmen umgesetzt hatten) wurde mit den vorgeschlagenen und umgesetzten Massnahmen eine Verbesserung des Gesundheitszustandes in 45% der Fälle bei der EMF-Gruppe und in 35% bei der Nicht-EMF-Gruppe erreicht.

Umsetzung eines Verbesserungsvorschlags	Besserung des Gesundheitszustandes	EMF-Gruppe n=20 (100 %)	Nicht-EMF-Gruppe n=34 (100 %)
Ja	ja/ ja, teilweise	9 (45 %)	12 (35 %)
	nein	8 (40 %)	12 (35 %)
Nein	nicht bekannt	3 (15 %)	10 (30 %)

Tabelle 7: Umsetzung und Erfolg von Verbesserungsvorschlägen

Umsetzung eines Verbesserungsvorschlags	Besserung des Gesundheitszustandes	EMF-Gruppe (20)		Nicht-EMF-Gruppe (33)	
		EMF plausibel 7 (100%)	EMF unplausibel 13 (100%)	Umweltätiologie plausibel 15 (100%)	Umweltätiologie unplausibel 18 (100%)
Ja	ja/ ja, teilweise	4 (57 %)	5 (39 %)	6 (40 %)	6 (33%)
	nein	2 (29 %)	6 (46 %)	2 (13 %)	10 (56 %)
Nein	nicht bekannt	1 (14 %)	2 (15 %)	7 (47 %)	2 (11 %)

Tabelle 8: Umsetzung und Erfolg von Verbesserungsvorschlägen, stratifiziert nach eingeschätzter Plausibilität der Umweltätiologie der Beschwerden.

In der Nicht-EMF-Gruppe fehlt eine Person, da die Umweltätiologie aufgrund fehlender Arbeitsplatzdaten nicht bewertet werden konnte.

Eine Stratifikation der Daten von Tabelle 7 in Untergruppen nach "plausibler" oder "unplausibler" Umweltätiologie der Beschwerden ergibt folgendes Bild (Tabelle 8): In der EMF-Gruppe wurden die vorgeschlagenen Massnahmen gleich häufig umgesetzt, unabhängig davon, ob die Fallkonferenz die Symptome als EMF-plausibel oder EMF-unplausibel eingestuft hatte.

Bei der Nicht-EMF-Gruppe fällt auf, dass fast die Hälfte der Teilnehmer, bei denen Umweltfaktoren als plausible Ursache bewertet worden waren, auf die Umsetzung der vorgeschlagenen Massnahmen verzichteten. Die Gründe dafür sind unklar. Soweit Verbesserungsvorschläge umgesetzt wurden, war dies bei der Nicht-EMF-Gruppe mit plausibler Umweltätiologie am erfolgreichsten (eine Verbesserung trat in 75% der Fälle ein), gefolgt von der EMF-Gruppe mit plausibler EMF-Ätiologie (67% der Fälle). Weniger erfolgreich waren die Massnahmen in den Untergruppen, bei denen EMF oder andere Umweltfaktoren als unplausibel für die Beschwerden bewertet worden waren (46 bzw. 38%).

Alle Teilnehmer/innen beschrieben vor Beginn des Projektes ihre Erwartungen an das Projekt. In der Nachbefragung wurden diese Erwartungen nochmals aufgegriffen und nachgefragt, ob sie erfüllt worden waren oder nicht (Tabelle 9).

Erwartungen erfüllt	EMF-Gruppe, 20 (100 %)	Nicht-EMF-Gruppe, 34 (100%)
Nein	9 (45 %)	8 (24 %)
Ja	6 (30 %)	9 (26 %)
Teilweise	4 (20 %)	8 (24 %)
weiss nicht	1 (5 %)	6 (18 %)
Keine Antwort	0 (0 %)	3 (8 %)

Tabelle 9: Erfüllung der an das Projekt gestellten Erwartungen

Sowohl in der EMF- als auch in der Nicht-EMF-Gruppe sah die Hälfte der Teilnehmenden ihre Erwartungen mindestens zum Teil erfüllt. Nicht erfüllt wurden sie in der EMF-Gruppe fast doppelt so häufig wie in der Nicht-EMF-Gruppe. Insgesamt unterscheidet sich das Antwortmuster der beiden Gruppen jedoch nicht signifikant.

3.2.10 Diskussion

In dieser Untersuchung konnten Gesundheitsdaten von insgesamt 25 Personen mit Messungen elektromagnetischer Felder verknüpft werden. Die Plausibilität eines Zusammenhangs zwischen gesundheitlichen Problemen und einer Belastung durch EMF wurde nach umfangreichen Abklärungen von einem interdisziplinären Team beurteilt. Fast alle Personen in dieser Gruppe von 25 Personen waren in ihrem Wohnbereich niederfrequenten elektrischen Feldern oberhalb der Nachweisgrenze von 3 V/m ausgesetzt. Eine nennenswerte Exposition gegenüber niederfrequenten magnetischen oder hochfrequenten elektromagnetischen Feldern fand sich nur bei wenigen Projektteilnehmer/innen. Alle festgestellten EMF-Messwerte lagen unterhalb der gesetzlichen Grenzwerte. Nach Abwägung aller Informationen wurden 14 von insgesamt 85 geschilderten Symptomen (16 %) bzw. Beschwerden bei 8 von 25 Personen (32 %) in der interdisziplinären Fallkonferenz als plausibel mit der EMF-Belastung zusammenhängend erachtet. Die Hälfte dieser Symptome waren Schlafstörungen, Müdigkeit oder Erschöpfung. Bei all diesen "plausiblen" Symptomen handelte es sich um kurzfristig (z.B. Kribbeln) bis mittelfristig (z.B. Schlafstörungen) einsetzende Einschränkungen des Wohlbefindens. Für 6 der 14 genannten Symptome waren die EMF die einzige plausible Ursache, für die übrigen Symptome wurden neben EMF auch medizinische oder psychologische Faktoren als plausibel erachtet.

Für die Plausibilitätsabschätzung war die erste Schwierigkeit, einen Schwellenwert festzulegen, oberhalb dessen eine EMF-Exposition im vorliegenden Kontext einer empirischen Annäherung an ein unverstandenes Phänomen als eine relevante Belastung anzusehen ist. Die international vorhandenen Grenzwerte eignen sich dazu nicht, da bei ihrer Herleitung die hier vorgefundenen Befindlichkeitsprobleme nicht einbezogen worden sind. So basieren beispielsweise die von der ICNIRP vorgeschlagenen Grenzwerte auf Schwellenwerten, oberhalb derer EMF nachweisbar durch eine Wärmewirkung oder eine

Zellstimulation einen schädlichen Effekt hervorrufen ^[4]. Tiefere Grenzwerte als diese berufen sich auf das Vorsorgeprinzip.

Die in diesem Projekt herangezogenen "Schwellenwerte" verstehen sich als Empfehlungswerte des beigezogenen Baubiologen. In diesem Projekt folgte die Verbindung des "Schwellenwertes" zusammen mit den weiteren Plausibilitätskriterien einem pragmatischen Ansatz, der jedoch nicht auf einer wissenschaftlichen Ebene Kausalität nachweisen kann. Eine Schwäche dieser Studie ist daher, dass dieser Ansatz einen inhärenten Ermessensspielraum hat, dem die unklare wissenschaftliche Evidenz zugrunde liegt.

Trotz der Schwierigkeiten mit der Interpretation der gemessenen EMF-Expositionen muss festgehalten werden, dass ohne die Messungen eine Bewertung der Exposition gar nicht möglich gewesen wäre. Obwohl kein rechtsverbindlich festgelegter Grenzwert überschritten wurde, erschien es dem Projektteam nach sorgfältigem Abwägen aller zur Verfügung stehender Informationen plausibel, dass bei einzelnen Personen Beschwerden durch EMF hervorgerufen worden waren.

Insbesondere die niederfrequenten elektrischen Felder sind aufgrund ihrer weiten Verbreitung schwierig zu beurteilen. In der vorhandenen Literatur zu niederfrequenten elektrischen und magnetischen Feldern werden nur in wenigen Fällen überhaupt elektrische Felder gemessen, und kaum je deren Bedeutung diskutiert ^[15, 16]. Dennoch erschien es dem Projektteam in einigen (wenigen) Fällen plausibel, dass Beschwerden mit niederfrequenten elektrischen Feldern im Zusammenhang standen.

Die in dem Projekt gemessenen maximalen Felder gingen von Haushalts- oder Bürogeräten aus. Für die Frage der "relevanten persönlichen Belastung" muss jedoch bedacht werden, dass die Exposition gegenüber Geräten im Allgemeinen von wesentlich kürzerer Dauer ist als beispielsweise die gegenüber ortsfesten Installationen. In diesem Projekt wurde es von dem interdisziplinären Team eher als plausibel erachtet, dass eine Exposition längerer

Zeitdauer gesundheitliche Auswirkungen zeigte, während sehr kurze (stärkere) Expositionen eher mit der Wahrnehmung von Feldern in Verbindung gebracht wurden. Diese Fähigkeit, ein Feld zu spüren, wird in einigen Studien unterschieden von dem Auftreten von Gesundheitsbeschwerden infolge der Felder ("Elektrosensitivität" versus "elektromagnetische Hypersensibilität"). Beides muss nicht aneinander gekoppelt sein^[16, 17].

Ein Zusammenhang zwischen gesundheitlichen Beschwerden und EMF war nicht in erster Linie aufgrund der gemessenen Stärke der EMF plausibel, sondern es mussten weitere Kriterien erfüllt werden. Dies macht insofern Sinn, als es bisher unklar ist, ob es überhaupt eine lineare Dosis-Wirkungsbeziehung gibt^[18, 19]. Auch wird diskutiert, ob lediglich ein kleiner Teil der Bevölkerung hypersensibel gegenüber EMF-Exposition reagiert. In einer schwedischen Studie berichten Hillert et al. über ca. 1.5 % der Bevölkerung, die sich selbst als elektromagnetisch hypersensibel einstuft^[20]. Eine kalifornische Studie berichtet über 3.2 %, die sich selbst "allergisch oder sehr sensibel" fühlt, wenn sie sich in der "Nähe von elektrischen Geräten aufhält"^[21]. Der Anteil an empfindlichen Personen dürfte also eher gering sein. Solange das Phänomen "elektromagnetische Hypersensibilität" nicht aufgeklärt ist, bleibt zudem unklar, inwieweit eine Überschreitung der Schwellenwerte bei nicht empfindlichen Personen relevant ist. Auch dies würde dagegen sprechen, bei allen Beteiligten lediglich die Messwerte zu betrachten und allein von der Stärke des vorhandenen Feldes eine Plausibilität abzuleiten.

Dazu kommt noch, dass möglicherweise nicht ein durchschnittliches Feld, also die Feldstärke gemittelt über die Zeit relevant ist, sondern eher die zeitliche Variabilität des Feldes. Eine amerikanische Studie fand beispielsweise einen Zusammenhang zwischen Fehlgeburten schwangerer Frauen und der Variabilität niederfrequenter Magnetfelder, während die durchschnittliche Stärke des Feldes überhaupt keinen Einfluss zeigte^[21]. In einer experimentellen Studie zeigte allerdings weder ein kontinuierliches magnetisches Feld, noch ein im 15-Sekunden-Rhythmus an- und ausgeschaltetes einen Effekt auf den Schlaf junger, gesunder Männer^[22].

Die Hälfte der Projektteilnehmer/innen hatte bereits seit mehr als drei Jahren Beschwerden (Hauptbeschwerde). Die meisten hatten ausserdem bereits bei verschiedenen Anlaufstellen Hilfe gesucht ^[13]. Die Verknüpfung von EMF-Belastungen mit medizinischen und/oder psychologisch-psychiatrischen Diagnosen bei einem grossen Teil der geschilderten Beschwerden spiegelt die Komplexität der in dem Projekt behandelten Probleme wider. Gemessen daran scheint ein Anteil von 34 % für die Nicht-EMF-Gruppe bzw. 45 % für die EMF-Gruppe von Personen, die mindestens einen der genannten Beratungsvorschläge mit Erfolg umsetzen konnten, hoch.

Das durchgeführte Projekt war mit einem Zeitbedarf von ca. 30 Facharbeitsstunden pro Person in der EMF-Gruppe sehr arbeitsaufwändig. In der Nicht-EMF-Gruppe lag der Zeitbedarf ca. 3.5 Stunden tiefer (ohne EMF-Messungen). Für eine zukünftige umweltmedizinische Beratungsstelle, in der auch EMF-Beratungen durchgeführt werden könnten, müsste dieser Aufwand auf ein pragmatisches Mass reduziert werden, das aber der inhaltlichen Komplexität noch gerecht werden muss. Wöchentlich stattfindende Beratungen eines Arztes/ einer Ärztin mit allergologisch/ internistischem Schwerpunkt und einer psychosomatischen Zusatzausbildung könnte den Aufwand für die medizinische und die psychologische Konsultation auf ein tragbares Mass verringern. Zusätzlich müsste sich eine solche Fachperson auf ein breites Netz von Umweltfachstellen und EMF-Fachleuten abstützen können, die jeweils zu Rate gezogen werden könnten.

Solange die Ergebnisse wissenschaftlicher Forschung im EMF-Bereich so in den Anfängen stecken und widersprüchlich sind, ist man im Einzelfall in der Umweltmedizin auf pragmatische Ansätze angewiesen. Im vorliegenden Projekt konnte so einem nicht kleinen Teil der Patienten mit konkreten Handlungsvorschlägen Hilfestellung geleistet werden.

3.2.11 Abkürzungen

BUWAL	Bundesamt für Umwelt, Wald und Landschaft
DECT	Digital enhanced cordless telephones
EMF	Elektromagnetische Felder
E-Feld	Elektrisches Feld
GSM	Global System for Mobile Communication: 2. Mobilfunkgeneration
HF	Hochfrequent, Frequenzbereich zwischen 100 kHz und 300 GHz
B-Feld	Magnetische Flussdichte
METAS	Bundesamt für Metrologie und Akkreditierung
μT	Mikrotesla, Einheit für die magnetische Flussdichte
NF	Niederfrequent, Frequenzbereich bis maximal 100 kHz
UMTS	Universal Mobile Telecommunications System: 3. Mobilfunkgeneration
V/m	Volt pro Meter, Einheit für die Stärke eines elektrischen Feldes

3.2.12 Danksagung

Das umweltmedizinische Beratungsprojekt wurde finanziert durch die Stiftung Mensch Gesellschaft Umwelt MGU, Förderkennzahl F3.00, dem Bundesamt für Gesundheit, BAG, Bern, dem Schweizerisches Zentrum für Allergie, Haut und Asthma, AHA!, sowie dem Wissenschaftlichen Kredit, Kantonsspital Basel-Stadt.

Die Messungen der elektromagnetischen Felder und dieser vorliegende Bericht konnten durch die grosszügige Förderung des Bundesamtes für Umwelt, Wald und Landschaft durchgeführt werden.

Ein herzlicher Dank gilt dem Feedback von Dr. med. Regula Rapp und Dr. med. Kerstin Hug sowie dem umfangreichen Input durch Dr. phil. Martin Rösli.

4 Evaluation of the project

4.1 Environmental Medicine Project in Switzerland: Did it Help?*

4.1.1 Introduction

The environmental medicine project Basel, Switzerland, counselled persons who related their health problems to environmental exposures. Complainants reported of symptom duration of several years (med. 3 yrs.) and having consulted physicians (69%) and/ or alternative health care services (60%) beforehand. Participants in the project presented complex problems, investigations were very time consuming. To evaluate the benefit of the study, participants' individual project perception was assessed about half a year after counselling.

4.1.2 Methods

All participants took part in medical and psychological-psychiatric examinations and were visited at home by the corresponding environmental agency. Results were discussed in a case conference and subsequently, counselling was offered. Finally, the project was evaluated, using telephone interviews that were conducted by a person not otherwise involved with the project.

Participants were asked about contentment with the assessments, time duration between enrolment and counselling and the advice-giving session. Further questions inquired about changes in the health status, fulfilment of expectations in the project, whether they would recommend participation in such a study to others and about the implementation of given advice and its effect. Each of these variables was tested with regard to age, sex, the

* published as an abstract as: *Huss A, Küchenhoff J, Bircher A, Heller P, Niederer M, Scartazzini G, Schwarzenbach S, Waeber R, Wegmann L (2003). Epidemiology, Vol 14, No 5, September Supplement*

occurrence of at least one psychiatric diagnosis and whether the team rated the suspected environmental exposure to be a plausible cause of the health complaints.

4.1.3 Sample

63 persons completed the study, mean age in the group was 54 years, 60% were female. In 40% of the cases the relation between environmental exposure and at least one health problem was rated to be plausible by the project team. Educational level was high: more than 50 % had a higher education (degree from an university or an university of applied sciences).

4.1.4 Results

54 of 63 project participants (86 %) could be interviewed for the evaluation. Descriptive results of variables of satisfaction and compliance are given in Table 4 and Table 5 below.

Most participants were very satisfied with the medical examination (89 %) and the project organisation as a whole (85 %), see Table 4. On the other hand, participants were least satisfied with the psychometric questionnaires (13 % not satisfied) and the joint advice-giving-session (13 %). Eleven persons (20 %) would have preferred not to have a joint counselling session, but meetings with just one person, especially the physician only (6, 11 %).

Satisfaction with...	n	Satisfied or very satisfied	middle satisfied	Not satisfied	missing
... the organisation of the project	54	46 (85.1 %)	3 (5.6 %)	3 (5.6%)	2 (3.7 %)
... the medical examination	54	48 (88.8 %)	3 (5.6 %)	2 (3.7 %)	1 (1.9 %)
... the psychometric questionnaires	54	33 (61.1 %)	12 (22.2 %)	7 (13.0 %)	2 (3.7 %)
... the psychiatric interviews	54	41 (75.9%)	7 (13.0 %)	5 (9.2 %)	1 (1.9 %)
... the home visit from the envir. hygienist	54	41 (75.9 %)	3 (5.6 %)	3 (5.6%)	7 (13.0 %)
... the additional home visit in case of EMF-measurements	20	13 (65.0%)	5 (25 %)	1 (5 %)	1 (5 %)
... joint counselling	54	35 (64.8 %)	7 (13.0 %)	7 (13.0 %)	5 (9.2 %)

Table 4: Satisfaction with organisation, assessments and counselling by the project participants

41 % of the participants describe a better health status in the telephone interview, compared to the health status at the time of enrolment, 11 % report worsening (see Table 5). These 11 % are not identical to the 11 % who would not recommend participation in the project to others. 50 % found their expectations in the project at least partly satisfied, but 30 % reported the opposite.

	improved	equal	worse	missing
development of health status	22 (40.7 %)	25 (46.3 %)	6 (11.1 %)	1 (1.9 %)
	yes	yes, but restricted	no	missing
recommendation of project to others	40 (74.1%)	4 (7.4 %)	6 (11.1 %)	4 (7.4 %)
	yes	partly	no	miss./ don't know
expectations in the project fulfilled	15 (27.8 %)	12 (22.2 %)	16 (29.6 %)	11 (20.4%)
	helped	helped partly	didn't help	missing
effect of implementation of given advice	14 (25.9 %)	6 (11.1 %)	20 (37.1 %)	14 (25.9%)

Table 5: Evaluation of health status, recommendation of the project to others, fulfilment of expectations and implementation of given advice by the project participants, n = 54

Improvement of health status (compared to equal/ worse health status) was negatively correlated to age and the occurrence of at least one psychiatric diagnosis and positively to an environmental aetiology of the health problems (all $p = 0.03$). Although the odds ratios remained more or less similar in a multivariate model, the confidence intervals widened and results were not statistically significant any more. Recommendation (yes/restricted versus no) of the project to other was not correlated to any of these factors (age, sex, occurrence of psychiatric diagnosis, environmental aetiology rated "plausible"). Fulfilled (or partly fulfilled) expectations in the project correlated negatively with age ($p = 0.04$) and positively with an

environmental aetiology of the health problems ($p = 0.05$). Successful implementation (compared to no success or no implementation) of given advice was positively correlated with an environmental aetiology of the health problem (borderline, $p=0.07$).

There was a tendency that those symptoms that got worse had already been present for a long duration at the time of enrolment (geometric mean 7 yrs, C.I. 3 – 15 yrs) compared to those that did not change (4 yrs, C.I. 3 – 7) or improved (3 yrs, C.I. 2 – 4 yrs.), (group difference, $p = 0.1$).

Overall, 19 of 54 participants (35 %) report having seen a physician or an "alternative" physician in the time interval between counselling and evaluation interview. However, health status at the time of the interview did not differ significantly between those who had visited a physician and those who had not ($p = 0.2$).

Those participants who felt better at the time of the interview described their expectations in the project more often as fulfilled ($p = 0.06$) and were those with a successful implementation of given advice ($p < 0.0001$). Persons with a fulfilled expectation would also recommend the project more often to others ($p = 0.01$) and had more frequently successfully implemented given advice ($p = 0.0006$).

4.1.5 Conclusions

Environmental aetiology of health problem rated 'plausible' and younger age were predictors that determined satisfaction of the participants of our environmental medicine project. Other reasons to approve or disapprove of the project are more likely to be found on an individual level. Worsening of the health status might be an effect of older age. Approximately one third of the participants were able to benefit of the interdisciplinary project approach to improve long lasting health problems where support had been sought in various health care settings beforehand.

5 General Discussion

5.1 Summary of the main findings

In the following, the research questions outlined in chapter 1.2.2 are answered in form of short summaries of the main findings that were discussed in detail in the respective chapters.

I) *What is the magnitude of environmental medicine counselling in general practice in Switzerland?*

In Switzerland, environmental medicine consultations in general practice are rare. The physicians of the Swiss Sentinel Surveillance Network reported that 0.03 % of all consultations were environment-related. There were considerable differences between physicians offering "alternative" medical therapies and the Sentinella physicians in the frequency of environmental medicine consultations. "Alternative" physicians reported 0.3 % of the consultations or around 10 patients per physician and year. In addition, the character of reported symptoms and suspected environmental exposures differed between the physician groups.

II) *What are characteristics of the environmental medicine project participants (e.g. attitude towards stress, use of 'alternative' health care services, reported illnesses), compared to a representative (symptomatic) sample of the Swiss population?*

Environmental medicine project participants had a higher level of education. A higher proportion had undergone a medical treatment because of chronic bronchitis or allergies and reported more sleep disturbances. A further characteristic of the study population was its higher use of alternative medical health care services and high expenditures for health care not covered by insurances. Little differences were found

with respect to coping styles, but project participants reported a much higher level of perceived control.

IIIa) What are the main findings of the medical, psychological-psychiatric and environmental assessments?

Predominant health complaints included unspecific or general and respiratory symptoms. Biological or chemical exposures from indoor sources (e.g. formaldehyde, mould) were the most common suspected environmental exposure, followed by electromagnetic fields.

Most frequent (somatic) medical diagnoses were diseases of the respiratory system and mucous membranes followed by diagnoses of general symptoms (such as headache, fatigue etc.), gastrointestinal diseases, skin and neurological diseases. Asthma diagnoses were more prevalent than in the general population.

Two thirds of the participants had at least one psychiatric diagnosis related to the health complaints in question. Most frequently diagnosed were personality disorders and somatoform disorders. Psychiatric diagnoses were more prevalent than in the general population.

No chemicals with levels described in the literature as toxicologically relevant could be measured in any of the homes. However, in five cases a relevant exposure could not be measured any more, but had evidently occurred in the past (pesticides, mixtures of diverse solvents, asbestos).

IIIb) How do health complaints and suspected exposures correspond to the findings of the medical, psychological-psychiatric and environmental assessments?

The simultaneous assessment of the symptoms yielded that of the reported

symptoms, 34 % were plausibly related to medical findings, 65 % to psychological-psychiatric findings and 24 % to environmental exposures. The summation of symptom plausibility was greater than 100 % because 28 % of the symptoms were judged to have multiple plausibilities i.e. findings from more than one assessment-field could plausibly explain the existence of the health complaint. At least one 'multiple plausible symptom' occurred in 51 % of the participants. This number is an indication of the complexity of problems presented by the participants in the environmental medicine project. Altogether, 40 % of the participants offered at least one plausible theory of the environmental aetiology of their symptoms.

IVa) What EMF exposure level can be found in the subgroup of participants who attributed their health complaints to electromagnetic fields?

Most of those 25 persons who suspected EMF as cause of their symptoms were exposed to low-frequency electric fields. Only few persons had an exposure of low-frequency magnetic or high-frequency electromagnetic fields above the detection limit, none of the legal threshold levels were exceeded in any of the homes.

IVb) How can the results of the measurements be evaluated with respect to their health relevance?

Relevance of the assessed electromagnetic fields was judged with a set of criteria: the fields had to exceed one tenth of the Swiss threshold values and the exposure had to occur in an area where the respective person spent several hours or more each day. In addition, a time and spatial context between the exposure and the health problem had to exist with the prerequisite that the exposure occurred before the onset of symptoms.

IVc) *How do reported health complaints correspond to the findings of the electromagnetic field (EMF) measurements?*

The project team rated symptoms from 8 of 25 participants (32 %) to be plausibly related to EMF. All these symptoms concerned reduced well-being such as sleeping problems or formication. Thus, the assessments gave an indication that few persons had an elevated susceptibility towards electromagnetic fields.

V) *How do the complainants describe their health approximately half a year after participation in the environmental medicine project? How many were successful in the implementation of given advice, and were the expectations into the project fulfilled?*

41 % of the participants reported an improved health status approximately half a year after counselling, 48 % reported no change and 11 % reported worsening.

37 % reported a successful implementation of the advice, 37 % report no success and 26 % no implementation. Environmental aetiology of the health problem rated as "plausible" and age were predictors that determined satisfaction of the participants of our environmental medicine project.

5.2 Discussion

The specific findings of this thesis have been discussed in detail in the respective chapters. In this chapter, more general aspects, the limitations of the study and the implications of the research results for environmental medicine counselling in Switzerland are discussed. The chapter concludes with a brief outlook into further activities.

5.2.1 General aspects of study results

Environmental medicine problems were rare in general practice in Switzerland, comprising 0.03 % of all consultations.

In the Basel pilot project, participants reported long lasting health problems. The majority of the complainants had sought help from a wide range of health care providers before enrolling in the study. Presented problems were complex: Every other patient had one or more symptoms that could be plausibly explained by concurrent findings from at least two disciplines. Diagnoses of psychiatric problems as causes were common. However, a psychiatric diagnosis did not exclude environmentally caused symptoms. More than a third of the participants implemented at least pieces of advice given during counselling successfully and described an improved health status approximately half a year after participation.

Psychologic-psychiatric burden

The proportion of participants with psychological-psychiatric problems in the Basel environmental medicine project group was high and could explain almost half of all reported symptoms (see chapter 3.1). Comparison of this finding to results of other environmental medicine counselling institutions or projects is difficult due to differences in methodological approaches. However, many studies of persons complaining about MCS (multiple chemical sensitivity) or IEI (Idiopathic Environmental Illness) show a predominance of psychological-psychiatric problems in these individuals (Black et al. 1990; Eis et al. 1995; Eis et al. 2002;

Davidoff et al. 1996; Fiedler et al. 1996; Blaschko et al. 1999; Black et al. 2000; Bornschein et al. 2000; Jason et al. 2000; Labarge et al. 2000).

As a result of this finding, the question has been raised as to whether "syndromes" in environmental medicine might just be variants of somatoform disorders (Wiesmüller et al. 2003). In the Basel project, 21 % of the project participants were diagnosed with a somatoform disorder (ICD 10 code F 45). These disorders were important but could not explain the majority of the presented problems. However, the study's findings strongly suggest that assessment of complainants' illnesses should always include a psychological-psychiatric component.

Eis et al., for the German MCS multi-centre study, reported that 40 % of the participants suspected to suffer from MCS (Eis et al. 2002). Although this proportion varied considerably between centres, with a range of 19 – 77 %, it is still much higher than in the Basel study, where only two persons (3 %) suspected to suffer from MCS. The high percentage of persons suspecting MCS in the German study might result from frequent media attention given to MCS in Germany (Dr. D. Eis, personal communication, 12. March 2004). The low proportion in the Basel project, on the other hand, might be due to the deep mistrust of these groups in "conventional" medicine in Switzerland and the fear of being "psychiatrised", i.e. a perceived one-sided explanation of health complaints as being caused by psychological-psychiatric problems (www.mcs-liga.ch and personal communication with Chr. Schifferle, chairman of the MCS-Liga Switzerland, 1. March 2004).

As psychological-psychiatric problems occurred so often in the participants of the pilot project, a more detailed qualitative analysis was conducted (Küchenhoff et al. 2004). Participants' self-rating of having a high or low psychological-psychiatric burden was extracted from psychometric questionnaires. Expert rating of psychological-psychiatric burden was assessed in case conferences. This analysis yielded four subgroups with either converging or diverging opinion. Each of these four groups shared distinct characteristics:

The first group with a low psychological-psychiatric burden in both ratings comprised those with the highest percentage of environmental exposures as a plausible cause of the health complaints. The second group rated themselves as having a high psychological-psychiatric burden but were rated with a low burden by the experts. This group was dominated by persons who described their psychological-psychiatric well-being as affected by chronic diseases. The third group rated themselves as having a low psychological-psychiatric burden but were rated with a high burden by the experts. Participants in this group were often characterised as having had difficult starting situations in life, but having managed to make their way in life with an enormous effort. Nevertheless, self-esteem in this group was fragile and the attribution of health complaints to the environment served as a relief, warded off fear of failure and stabilised self-esteem. The fourth group (high psychological-psychiatric burden in both participant and expert ratings) shared a history of strong psychosocial burden and biographical trauma. A fixation on bodily symptoms seemed to be a surrogate of self-care.

Converging opinion between patients and therapists of the theory of the aetiology and course of psychological-psychiatric burden have been shown to be an important factor for successful psychotherapies (Deale et al. 2001). A converging opinion thus includes not only the acknowledgment of the existence of a psychological-psychiatric burden, but also the acceptance of its aetiological relevance.

The advice given in the counselling session of the project included advice from medical and psychiatric-psychological specialists as well as from environmental specialists. Possibly because the advice given was of a general nature, membership of one of the four subgroups was not an influential factor in the ability to successfully implement advice.

High percentage of environmental exposures rated a "plausible" cause

The main difference of the results from the Basel project compared to several German studies, for example the MCS-study (Eis et al. 2002) seems to be the higher proportion of participants in the Basel project whose health problems had a "plausible" environmental

aetiology. Environmental medicine studies in Germany show that environmentally related symptoms occur in less than 10 % of complainants (Koppel et al. 1995; Schulze-Röbbecke et al. 1999; Brölsch et al. 2001; Herr et al. 2004). One environmental medicine centre reported that patients mainly presented with a mixture of allergologic and psychiatric problems but few environmental exposure-related problems (Eberlein-König et al. 2002).

The difference between the Basel project and others might originate from differences between criteria for evaluating plausibility of the relation between environmental exposures and the health complaints. For example, results of the MCS-study in Germany show that there are considerable differences in the interpretation of criteria between centres: A causal relation of the exposure and the symptoms was rated "probable" or "very probable" in 78 % of the participants of the Bredstedt centre. However, in the Giessen centre, these ratings never occurred. The authors speculated whether different "pathogenetic concepts" of the physicians might account for the differences between the centres (Eis et al. 2002).

Another reason for the higher percentage of environmental "plausible" cases in Basel might be that health complaints and suspected exposures differ to those of the German projects. For example, respiratory symptoms were more commonly reported in Basel than in the MCS-study (Eis et al. 2002). In the Basel study, persons reporting respiratory symptoms were significantly more likely to be classified as having a "plausible" environmental aetiology than those who described other health complaints (see chapter 3.1). Although symptoms reported in the Basel project were more or less similar to those reported in projects in Aachen, Augsburg and Munich (Brölsch et al. 2001; Eberlein-König et al. 2002; Schulze et al. 2004), there were differences with respect to the suspected exposures. Virtually none of the Basel participants suspected amalgam or wood preservatives which were the two most frequently suspected exposures in the MCS study and in several other German studies. In Switzerland, persons concerned about amalgam are more likely to seek advice from a dentist or specialist physician (see chapter 2.1). There is, as yet, no consensus regarding health effects that may be due to Amalgam or wood preservative exposures (Gupta et al. 1997; Gottwald et al.

2001). It might be speculated that the higher proportion of people who suspect these controversial environmental exposures would have led to a lower proportion of environmentally "plausible" health complaints. On the other hand, EMF played an important role in the Basel project but were not suspected as cause of the health problems in other studies. EMF, as cause of health problems, are about as equally controversial as Amalgam or wood preservatives.

In an environmental medicine study in Giessen, Germany, of 392 persons who contacted the outpatient unit, only 58 (15 %) finally participated in the study (Herr et al. 2004). This contrasts with the response rate in Basel where 46 % of contacted persons eventually participated. Apparently, different recruitment methods or selection criteria were used and the studies may not be comparable.

Another reason for the higher percentage of environmentally "plausible" health complaints might result from our approach of assessing environmental exposures by means of systematically conducted home visits by the environmental agencies. The German MCS-multi-centre-study emphasised human-bio-monitoring (assessment of exposures in body fluids) as means of detecting environmental exposures and only 12 % of the participants were visited at home (Eis et al. 2002). There have been peer-reviewed publications critically discussing the relevance of the environmental findings as assessed in human-bio-monitoring (Straff et al. 2002; Schulze et al. 2004). In our project we could include indoor climate parameters in our environmental assessments. Parallel to the findings of most other environmental medicine projects however, we found no indications of levels of chemicals, described in the literature as toxicologically relevant, in any of the homes in the Basel project. Systematically conducted home visits give the opportunity to pick up less obvious exposures, as for example high carbon dioxide levels at night indicating insufficient ventilation. Insufficient ventilation has been shown to be associated to adverse health outcomes, especially respiratory illnesses (Seppänen et al. 1999). Hutter et al. emphasised the necessity of home visits to identify potential risk factors possibly overlooked by the

participants (Hutter et al. 2001). Since home visits seemed necessary for the determination of environmental exposures, they should be included as one of the central elements of environmental exposure assessments in environmental medicine counselling.

Is environmental medicine counselling useful?

Assessments of satisfaction with environmental medicine counselling have been reported in peer-reviewed publications (Nagel et al. 1994; Hutter et al. 2001; Arcan et al. 2002; Herr et al. 2004). However, the project evaluations differed considerably with respect to the questions that were asked. Whereas 37 % of the Basel project participants reported an improved health status after implementation of at least one of the given recommendations; 18 % in the Aachen project described an improvement (Arcan et al. 2002). Approximately 2 years after enrolment, 38 % of the patients felt better or reported no complaints in Giessen, Germany (Herr et al. 2004). Taking into account that complainants generally report that their problems are of a long duration, and the complexity of the presented problems; these results show that patients attributing their health problems to environmental exposures can benefit from interdisciplinary environmental medicine counselling.

5.2.2 Limitations and problems of this study

One of the limitations to the study was that it was of case series design. Case series are unlikely to provide sufficient evidence to demonstrate a causal relation between defined exposures and an outcome (Rothman et al. 1998, Gordis 2000, Hennekens et al. 1987). Even when environmental exposures have been shown to be related to health outcomes in epidemiological studies, causality is generally difficult to demonstrate in individual cases. Thus, in the environmental medicine project, plausibility, rather than causality, of a relation between exposure and symptoms was tested.

To estimate a plausible relation between the exposure and the health complaints, a pragmatic approach was chosen based on several criteria that had to be met for a "plausible" rating. Peer reviewed scientific reports were the basis from which environmental exposures

and their health effects were evaluated. However, there are considerable gaps in published research.

In the case of EMF for example (see chapter 3.2), gaps include uncertainty regarding whether a dose-response relation exists (Marino et al. 2000), whether the variability of EMF might be more important than EMF-maxima (Lee et al. 2002) or whether exposure to different frequencies might be related to different health problems (Neutra et al. 2001, Leitgeb et al. 2003).

Legal threshold values and regulations should give a clear indication of perceived risk. Depending on the source of the field, however (see chapter 3.2), these threshold values vary widely both within Switzerland and between Switzerland and its neighbours, and thus cannot be used for the estimation of a plausibility of a health effect. In summary, the extensive assessments carried out in the Basel project gave an indication that few persons had an elevated susceptibility towards EMF. Further research will be needed to elucidate these relations.

Persons with health complaints attributed to environmental exposures have been shown to use the health care system more often than matched controls (Sabo et al. 2000; Gibson et al. 2003), and this has been shown to be related to frequent changes of the physician (Eis 1999; Hornberg 1999). This so called "doctor shopping" has been defined as changing of doctors without professional referral in the same illness period (Lo et al. 1994; Leung et al. 2003). Among other factors, like e.g. the physician-patient relationship, it is associated to chronicity of illness (Sato et al. 1995).

If indeed "doctor shopping" is present in environmental medicine patients, its prevention would help reducing associated health care costs.

In the Basel study, we gathered information about the use of the health care system before and after participation in the project. Project participants had used alternative health care services more often and spent more money for health care than a symptomatic sample of the

general population. Independent of the reported health status at the time of the evaluation interview, 37 % of the participants report having consulted a physician or "alternative" physician in the time period between advice-giving and the interview. An obvious limitation of our project is that we cannot differentiate consultations that derive from regular visits due to chronic illness or new illness periods. Predictions on the prevention of "doctor shopping" and whether health care costs can be reduced with an interdisciplinary environmental medicine approach can therefore not be made. A follow-up of the participants might improve knowledge on the effectiveness of interdisciplinary environmental medicine counselling over a longer time period.

A further limitation of the study was that we could not specify which advice was more or less often implemented. The counselling session itself was not recorded. In particular, there are no records of what advice was passed on to participants. The interviewers for the project evaluation were not involved in any other project assessments and apart from answering standardised questions, participants could freely characterise their view of the project. However, because psychological-psychiatric advice is rather sensitive and reports of the implementation of specific advice was generally not asked for by the interviewers.

Persons interested in participation were prepared to travel to Basel from as far as Liechtenstein and the Ticino. Due to the restrictions in counselling, only residents of the area of Basel were eligible to participate. This limitation was set by the organisation that financed the project. In addition, project resources did not enable recruitment over such a large area. Brölsch et al. (Brölsch et al. 2001) showed that environmental exposures suspected to cause health complaints vary by time and area. Inclusion of other areas might have thus changed the range of suspected exposures. An extension of the project area might have also yielded some more cases. However, given the large range of suspected environmental exposures it would be reasonable to predict similar study results for the rest of Switzerland.

5.2.3 Implication for future environmental medicine counselling

In answering the question of whether environmental medicine counselling in Switzerland is necessary, several views have to be considered: that of the complainants, that of the physicians and that of the environmental agencies.

The results of the environmental medicine project strongly suggest that only an interdisciplinary structure including medical, psychiatric and environmental expertise is likely to adequately diagnose health problems and advise persons with symptoms attributed to environmental exposures. Although only a limited number of persons of the whole population seem to be concerned, those who are, are in need of an advice that cannot be provided by the existing structures. A considerable percentage of the participants in our project as well as those in other environmental medicine counselling studies (Nagel et al. 1994; Hutter et al. 2001; Arcan et al. 2002; Herr et al. 2004) benefited from the interdisciplinary environmental medicine counselling. This shows that such a structure seems necessary and useful for complainants.

Information from one year's surveillance by the Swiss Sentinel Surveillance Network, showed that over, relatively few consultations per physician in General Practice were reported to be environmentally related, giving a total of approximately 8500 consultations in one year. For the majority of these consultations, the physicians reported that medical advice alone was adequate to address the problems.

On the other hand, the questionnaire that was answered by physicians did not include an item measuring psychological-psychiatric factors. This study and others strongly suggest that psychological-psychiatric factors may be responsible for some health complaints. Reporting by physicians was probably biased to identifying environmentally "plausible" cases as those cases with exposures that have already been identified as possible causes of health complaints for some time in the scientific literature (see chapter 2.1). In only 2 % of the environmentally related consultations, were patients encouraged to seek additional help from

an environmental agency. This might be interpreted as showing that, from point of view of the general practitioners, interdisciplinary environmental medicine assessments are not perceived as an important and necessary component of the health care system. One of the lessons of the environmental medicine project was, however, that all participating professionals became aware of their own limits the moment other areas of expertise were included in the assessments and information and data were exchanged.

On the other hand, this survey was representative of GPs, internists and paediatricians only. Interest in contributing to an interdisciplinary assessment may vary by specialisation of medical professionals. For example, from 17 persons interested in participation in the environmental medicine project who were referred by their physician, 6 (35 %) came from the allergology unit of the university hospital of Basel. Environmental medicine cases may be more frequent in these specialisation units: Allergological problems were common in environmental medicine participants in our project (see chapter 3.1) as well as in other studies (Schulze-Röbbecke et al. 1999; Eberlein-König et al. 2002). Alternatively, the higher percentage of referrals by the University Hospital in Basel may have occurred because more physicians in this unit were acquainted with the project.

There is a small, but distinct need for interdisciplinary environmental medicine counselling by the professionals in the environmental agencies (see chapter 2.1) who in general lack the medical or psychological-psychiatric expertise. Whereas the Swiss Toxicological Information Centre has reported a trend of increasing numbers of consultations over the last 10 years (Schw. Toxi. Informationszentrum 2003), others like the State Laboratory Basel-City reported no such trend. However, we could show that persons with health problems approach these agencies for advice. Thus, an interdisciplinary environmental medicine counselling structure would be a useful supplement to the counselling that is already provided by the agencies.

5.3 Outlook

Knowledge about low-dose environmental exposures and health complaints is limited. Some specific gaps in the knowledge of low-dose exposures and their health effects may never be filled, for example health effects from different mixtures of solvents, etc. However, other gaps such as concerning electromagnetic fields are more likely to be filled, given current progression in knowledge. However, these gaps in knowledge may be better addressed by analytical studies, than further studies of case series.

A consensus regarding criteria to be used in defining an environmental exposure as a "plausible" or "implausible" cause of health complaints is needed. The questions put forward by Sparks, about which items should be assessed in the case of a patient suspecting idiopathic environmental illness, provide a basis for the development of such criteria (Sparks 2000). Apart from the questions about dose, similar questions have been discussed in the Basel study (see chapters 3.1 and 3.2). Consensual criteria would facilitate comparisons between studies.

The underlying hypothesis providing the background to this project is that efficient counselling of environmental medicine leads to an improved health status of the participants and subsequently, to a reduced availment of health care. This project provided support for this hypothesis in that participants reported that advice given had been helpful in alleviating problems. The question of whether environmental medicine counselling could reduce "doctor shopping" was not addressed. Future evaluations should include measurement of "doctor shopping" into the assessment of the efficacy of environmental medicine counselling.

In 1999 the Swiss Government proposed an article in the new federal law on chemical substances (ChemG 2000) that would have set a legal basis for measures against indoor pollution, e.g. specific declarations on products for indoor use, or restrictions or bans, and for setting air quality standards in non-industrial environments ("Wohngiftartikel"). This article

was rejected by the Parliament in summer 2000. Thus, environmental agencies still lack a rationale to provide in-depth consultation such as home visits or measurements, to people complaining about environmental exposures. There are a few exceptions like e.g. the State Laboratory Basel-City that has an explicit assignment in prevention. This assignment permits the State Laboratory to perform home visits and, within limitations, measurements. Although other agencies do not have this function, some still do counsel persons approaching their institution for advice. However, the absence of a legal basis may pose a problem in times of decreasing governmental budgets. The government of the canton Basel-Landschaft for example is momentarily (2004) trying to reduce services that are conducted without an existing legal requirement (communication with Dr. J. Tremp, Amt für Umwelt und Energie, Liestal, Basel-Landschaft, 19. Feb. 2004). Existing environmental counselling could thus be reduced in order to save money. Consequently, this could pose a serious problem for an anticipated future environmental medicine network which would have to rely on the expertise from environmental agencies (see below). It might not be sufficient to leave environmental exposure assessments entirely to private laboratories who have an economic interest in performing measurements and whose services may only be available to a more affluent part of the population.

In general, participants in the Basel pilot project reported several symptoms and suspected more than one environmental exposure as the cause of symptoms. "Plausibility" assessments were conducted for each exposure and each symptom separately. This approach was adequate for the complexity of the presented problems. On the other hand, it was extremely time intensive with almost 30 hours work time required for each participant. If a structure for environmental medicine is to be implemented in the Basel area, it will have to maintain the balance between adequate assessment and costs. Project team recommendations include pooling the medical and the psychological-psychiatric examination: If a physician with an advanced training in psychiatry and knowledge in internal medicine or allergology could

integrate both of these assessments, the required time (and therefore financial resources) could be reduced significantly. Environmental experts, however, should always be consulted. Existing local environmental protection agencies would be well qualified to have this role as they have the experience and could, when necessary, carry out a home visit.

Annual demand for the proposed environmental medicine counselling structure in Basel would probably not exceed consultation numbers in the environmental medicine project; approximately 50 – 70 consultations per year. A proposal for an environmental medicine counselling service in the Basel area is currently under discussion (April 2004).

6 Part V: Annex

6.1 Abbreviations

BUWAL	Swiss Agency for the Environment, Forests and Landscape
CFS	chronic fatigue syndrome
DECT	digital enhanced cordless telephones
E-Feld	electric field
e.g.	exempli gratia (= for example)
EMF	electromagnetic fields
GP	General practitioner
GSM	Global System for Mobile Communication: second generation of mobile communication systems
HF	High frequency, frequencies between 100 kHz and 300 GHz
H-Feld	magnetic field
i.e.	id est (that is)
MCS	Multiple chemical sensitivities
METAS	Swiss Federal office for metrology and accreditation
NF	Low frequency, frequency range to maximum 100 kHz
μ T	Microtesla, unit for the magnetic flux density
SBS	Sick building syndrome
SHS	Swiss Health Survey
PCB	Polychlorinated biphenyl
UMTS	Universal Mobile Telecommunications System: third generation of mobile communication systems
V/m	Volt per meter, unit for the strength of the electric field

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6.3 Curriculum vitae

NAME: Anke Huss
DATE OF BIRTH: August 18th 1970
CITIZENSHIP: German

POST GRADUATE TRAINING

April 2000-April 2004 Project assistant and PhD student in Prof. Braun-Fahrländer's group, Department Environment and Health, Institute for Social and Preventive Medicine, Basel, Switzerland. Swiss pilot project on environmental medicine

July 1998 – Jan 2000 Foundation member of the association AKZENT E.V. – working group for sustainable development, Kiel, Germany (emphasis on the Agenda 21, environmental education)

February – April 1998 Short-contract GTZ, (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, International Development Cooperation), Eschborn, Germany (project coordination)

January 1998 Internship in Freiburg i. Br., Germany, Bureau for town planning (local agenda)

EDUCATION

February 1997 Diploma, grade 'very good'
Diploma thesis 'Gender Interests in City Planning – Comparison of the cities of Hamburg and Dortmund'

February 1992 BA, grade 'very good'

1989 – 1997 Studies of geography, Christian-Albrechts University of Kiel, Germany

FURTHER TRAINING

- 2000 - 2004 'Advanced Course on Epidemiological Analysis', London School of Hygiene and Tropical Medicine, England (lecturers: Smith P, Weiss H, Cousens S, Hayes R, Fielding K, Sterne J, Hardy P, Higgins C, De Stavola B, Watt H)
- 'Biometry for Epidemiologists', Swiss Tropical Institute in Basel, Switzerland (lecturers: Smith T, Vounatsou P)
- Master of Public Health postgraduate training course: 'Methods in Epidemiology', Institute for Social and Preventive Medicine, Zürich, Switzerland (lecturers: Colford J, Heusser R, Reingold A, Kent Ch, Zwahlen M)
- Master of Public Health postgraduate training course: 'Questionnaire Design', Zürich, Switzerland (lecturers: Rehm J, Frick U)
- Master of Public Health postgraduate training course: 'Environmental Epidemiology', Institute for Social and Preventive Medicine in Basel, Switzerland (lecturers: Dockery D, Schwartz J, Ackermann-Liebrich U, Braun-Fahrländer C)
- Master of Public Health postgraduate training course: 'Reading epidemiological papers' (lecturer: Künzli N, Ackermann-Liebrich U)
- Colloquium at the ISPM Basel: diverse with various lecturers

STIPENDS

Freiwillige Akademische Gesellschaft Basel (Academical Society Basel):

PhD stipend for 2003