Gender-specific aspects of exposure

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ABSTRACT
Knowledge about gender-relate exposures is rare. Therefore, based on a patient collective in environmental medicine gender specific aspects of surrounding exposures were investigated. Questionnaire data of 656 women and 501 men, who have to be affected by environment-related health disorders were retrospectively analyzed. Gender specific differences and risk factors were determined by frequency distributions. Significant differences between women and men could be shown for exposures at home and workplace, for behavioral risk factors, and for health effects. Therefore we compulsory demanded that gender specific aspects have to be considered in the practice of environmental medicine, especially in indoor air problems. Furthermore it is strongly recommended to verify the observed results in a prospective, gender specific study.

INDEX TERMS
environment, gender, health effects, occupational health, strategies

INTRODUCTION
Because environmental agents have been suspected as possible causes of health problems, advisory centers for environmental medicine were established in Germany at the end of the 1980s (Seidel et al., 2002). Assumed indoor air factors are still predominantly reasons to consult an advisory center for environmental medicine (Hornberg et al., 2003). But in less than 10% of the patients a plausible correlation between the patients' complaints and environmental factors can be established (Brölsch et al., 2000; Wiesmüller et al., 2002a, Wiesmüller et al., 2002b). It is assumed that this number is largely underestimated, due to a lack of knowledge about the real bio-psycho-social interactions between environment, humans' health and gender specific aspects. Several reasons can be stated:
First of all, gender research was a domain of social sciences. No more than 10 years ago a special bio-medical research of gender specific aspects in disease and health started, like e.g. about gender specific risk factors for heart and circulation diseases (Hippisley-Cox et al., 2001). Consequently the database is still insufficient for a valid bio-medical explanation of different diseases and different health in women and men (Goldschmidt, 2001). Actually, in environmental medicine and especially in indoor air research no specific gender related knowledge exists (Stenberg et al., 1994; Brasche et al., 2001; Bullinger et al., 1999). Therefore, aim of the present study was to investigate whether gender specific aspects of exposure in living environment exist which might be considered generally in environmental medicine and especially in indoor air problems. For this, data of the patient collective of the

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former consulting Center for Environmental Medicine (CEM) of the Medical Institute of Environmental Hygiene in Duesseldorf, Germany, were investigated.

METHODS

Patient data

Between 1989 and 1996, consultations of 695 women and 545 men (≥ 13 years) as well as of 33 girls and 44 boys (< 13 years) were documented at the CEM Duesseldorf. The present paper focused on the data of the 1,240 adults. With respect to the aim of the present study, questionnaire data of 656 women and 501 men, which includes information on the patient's history, signs and symptoms (the term symptom(s) will henceforth be used to mean signs and symptoms) as well as possible exposures in the patient's living surroundings, could be assessed. Between 1989 and 1991, the questionnaire data were not electronically archived. Therefore, these questionnaire data were retrospectively electronically assessed using EpiInfo. Since 1991, the questionnaire date were available as dBASE IV files based on a questionnaire-based PC-assisted patient-information-system (Neuhann et al. 1992).

Statistical analysis

The relationship between dependent and independent variables and gender was calculated using Pearson's χ^2-test and Fisher's exact test. For categorical or ordinal characteristics Pearson's χ^2-test or Fisher's exact test was used dependent on the number of expressions. The calculation of an exact distribution was done by Fisher's exact test for tables until three expression, in case of tables with four and more expression Pearson's χ^2-test was used. All tests were done two-side. An α-value of 0.05 was accepted as statistically significant.

RESULTS

Women (n = 272) and men (n = 246) suspected at least one and maximum 13 environmental agents as causative exposure. Men stated on average 3.2 (75^{th} percentile: 4), women 2.6 environmental agents (75^{th} percentile: 3). Men suspected significantly more often fibers (mineral, asbestos, and glass fibers) as causative exposure than women, women significantly more often synthetic material. Men suspected significantly more often their occupation as relevant exposure location than women (table 1).

Women had significantly more often a regular day, were significantly more often alcohol abstinent, smoked significantly less, and did significantly rarer regular sport activities than men (table 1). Independent from regularity, 13% men and 18% women did no sport activities.

Women lived significantly more often in apartment houses and significantly rarer in detached or semidetached houses and stayed significantly longer at home than men (table 1). Women were significantly more often exposed to cleaning products ($n_F = 419$, $n_M = 298$; Fisher's exact test; $p = 0.000$) as well as to cosmetic care products ($n_F = 419$, $n_M = 298$; Fisher's exact test; $p = 0.043$) than men.

Women belongs significantly more often to the occupation group 1 and 3 than men (figure 1). Physical exposures at the workplace (noise, heat, dust, vapor, and vibration) were significantly more often stated by men than by women. Women were significantly rarer in shift-work, wore significantly rarer protective clothes at workplace, and worked significantly rarer at workplaces with decree for harmful substances or other protective regulations than men. Occupational medical check-ups were significantly rarer done in women than in men. Women had a significantly fewer time of journey to the workplace than men (table 1).

In leisure time, between women and men no significant differences concerning activities and possible exposures were observed.

Not significant differences between women and men are listed in table 2.

Table 1: Significantly differently observed variables in women and men.

variable	expression	number of women (n_F) men (n_M)	test	p-value
exposure to fibers	no, yes	n_F = 271, 34 n_M= 244, 77	Fisher's exact test	0.000
exposure to man made material	no, yes	n_F = 263, 62 n_M= 243, 85	Fisher's exact test	0.039
exposure at occupation	no, yes	n_F = 165, 165 n_M= 129, 181	Fisher's exact test	0.039
regular day	no, yes	n_F = 66, 364 n_M= 68, 239	Fisher's exact test	0.02
alcohol intake	no, yes	n_F = 185, 333 n_M= 106, 263	Fisher's exact test	0.03
smoking	no, yes	n_F = 394, 101 n_M= 256, 90	Fisher's exact test	0.04
regular sport activities	no, yes	n_F = 348, 163 n_M= 223, 139	Fisher's exact test	0.051
type of dwelling	houses for several families, detached family houses, two family houses, multi-storage building	n_F = 232, 224, 12 n_M= 193, 130, 10	Pearson's χ^2-test	0.046
on average stay at home	> 1 hour/day, < 9 hours/day, 9-18 hours/day, > 18 hours/day	n_F = 3, 57, 235, 87 n_M= 0, 54, 202, 10	Pearson's χ^2-test	0.000
exposure to noise at work	no, yes	n_F = 150, 144 n_M= 114, 168	Fisher's exact test	0.012
exposure to heat at work	no, yes	n_F = 186, 90 n_M= 145, 126	Fisher's exact test	0.001
exposure to dust at work	no, yes	n_F = 166, 119 n_M= 127, 145	Fisher's exact test	0.007
exposure to vapor at work	no, yes	n_F = 199, 78 n_M= 143, 130	Fisher's exact test	0.000
exposure to vibration at work	no, yes	n_F = 234, 17 n_M= 195, 29	Fisher's exact test	0.000
shift-work	no, yes	n_F = 245, 35 n_M= 204, 60	Fisher's exact test	0.002
protective clothes	no, yes	n_F = 386, 50 n_M= 247, 66	Fisher's exact test	0.000
occupational medical check-ups	no, yes	n_F = 398, 29 n_M= 244, 58	Fisher's exact test	0.000
workplaces with decree for harmful substances or other protective regulations	no, yes	n_F = 384, 43 n_M= 232, 70	Fisher's exact test	0.000
time of journey to the workplace	< 15 min 15-30 min 30-45 min > 60 min	n_F = 98, 79, 49, 5 n_M= 88, 66, 52, 21	Pearson's χ^2-test	0.009

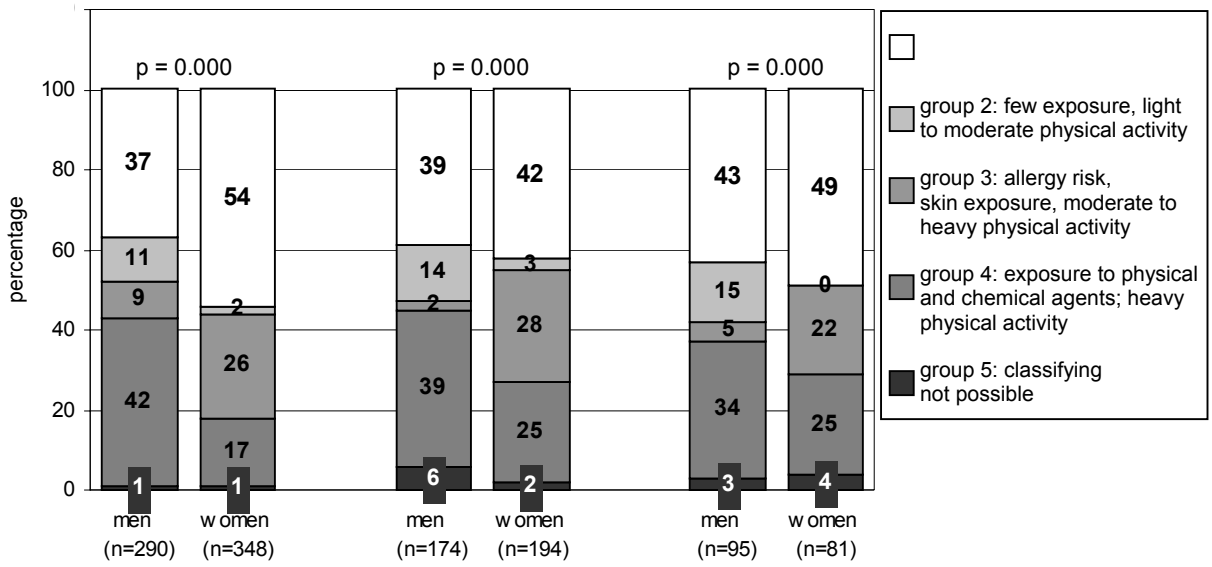

Figure 1. Significant differences in the actual and the previous occupation of women and men.

Table 2. Not significantly different variables in women and men.

– dioxins / furans – disinfectants – paints / lacquer – formaldehyde – herbicides / fungicides – wood preservatives – adhesives – solvents – metals / heavy metals – radioactivity / radiation – dust (not more specified) – other substances (not specified) – exposure dwelling – exposure dental materials – exposure leisure time – exposure unspecific (overall, in the car, in the hotel, in the drinking water) – eating habits – food intolerance – caffeine-containing beverages – environmental tobacco smoke exposure – previous type of dwelling – seize of dwelling – age of residential building – residential area (nearby rural area, traffic-loaded streets/highways, industrial area, industrial plants, green area)	– annoyance through noise, exhaust/traffic/industrial plant, mould in the dwelling – annoyance through noise, exhaust/traffic/industrial plant, mould, others in the residential area – living satisfaction – heating system – fuel – ventilation system, air condition – open fireplace – supply of energy for the cooker – heating in the bathroom – measuring instrument for the heater – unusual features of the room equipment – non-flowering plants in the dwelling – pets in the dwelling – number of pets – air condition at the workplace – visual display unit work – infection risk – lighting problems – odor exposure – exposure to other hazardous agents at the workplace – means of transport to the workplace – job satisfaction

DISCUSSION

The different statements of women and men about exposure to possible harmful

environmental agents and about the main exposure location at workplace can be explained with the gainful employment proportion of women (63%) which is lower than that of men (80.2%) in Germany (StBA, 1998). The suspected causative exposure of men fits to the traditional job outline of blue-collar worker or manual worker, which is associated with physical and chemical exposures as a rule.
That women had a more regular day than men may be associated with the observation that women were rarer in shift-work and had a fewer time of journey to the workplace than men.
That men drink more alcoholic beverages and smoke more than women is well known in literature (Goldschmidt et al., 2001; Kirby et al., 2002). The proportion of smokers in the present study (22.7%) is lower than in the general German population (33.1%) (Junge and Nagel, 1999) what might be explained, that patients with environment-related health disorders have a more pronounced healthy consciousness than the general German population. This interpretation can be supported by the observation in the present study that markable fewer people did no sport activities (13% men, 18% women) than in the general German population (43.8% men, 49.5%) (Mensink, 1999).
Due to the fact that women live more often alone than men and the proportion of single women households in Germany amounts to 58 % (StBA, 1998) it is comprehensible that women live in smaller accommodation units, as shown in the present study. The still existing gender division which attributes housework and family care to women, and the fact that women are rarer occupied than men (StBA, 1997) explain that women stayed significantly longer at home than men.
In this context it stands to the reason that women are more exposed to cleaning products than men. The well-known influences of the media on necessity creation, consumption, mediation of norms and role stereotypes mirror in the present study not only the use of cleaning products but also the usage of cosmetic care products. Data of social sciences and trade strategy research demonstrate that the use intensity of skin care products varies with gender (www.ikw.org/Koeper_und_Pflege.pdf). Gender specific application and individual sensitivity to substances in cosmetic care products may result in gender specific risk for health disorders (Stopper and Gertler, 2002).
In Germany, women are more frequently occupied in the services sector (57% women), commercial and traffic sector (48.6% women) than in the production sector (23.7% women) (StBA, 1997). This is reflected in the present study by the affiliation of women to occupation groups as well as the described workplace situations.
The results of our investigation show that women and men are differently exposed at workplace and at home, meaning indoors. Therefore, gender specific aspects must be considered generally in environmental medicine and especially in indoor air problems.

CONCLUSION AND IMPLICATIONS

Even now it must be compulsory demanded that gender specific aspects have to be considered in the practice of environmental medicine, especially in indoor air problems, which are predominant reasons to consult an advisory center for environmental medicine. In conclusion, our results must be proven in a prospective gender specific environmental medical study.

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REFERENCES

Brasche S, Bullinger M, Morfeld M, et al., 2001. Why do women suffer from sick building syndrome more often than men? – Subjective higher sensitivity versus objective causes. *Indoor Air* 11, pp 217-222.

Brölsch O, Schulze-Röbbecke R, Weishoff-Houben M, *et al.* 2000. Environmental medicine: eight-year experience from the Outpatients' Unit of Environmental Medicine at the University Hospital Aachen. *Allergologie* 24, pp 237-252.

Bullinger M, Morfeld M, von Mackensen S, *et al.*, 1999. The sick-building-syndrome – do women suffer more? *Zbl Hyg Umweltmed* 202, pp 235-241.

Goldschmidt S, Merbach M, and Brähler E, 2001. Wer sind die gesünderen Menschen? Geschlechtsspezifische Aspekte von Gesundheit und Krankheit. In *Perspektiven der Frauen- und Geschlechterforschung*, Gleichstellungsbeauftragte der Universität Leipzig, ed. Leipzig: Leipziger Universitätsverlag, pp 161-192.

Hippisley-Cox J, Pringle M, Crown N, *et al.*, 2001. Sex inequalities in ischaemic heart disease in general practice: cross sectional survey. *Brit Med J* 322: 832.

Hornberg C, Mourheg S, Siao GS, *et al.*, 2003. Indoor air related health disorders: experiences of an advisory center for environmental medicine. In *Proceedings of Healthy Buildings 2003*.

Kirby RS, Kirby MG, and Farah RN, eds. 2002. *Männerheilkunde.* Bern: Hans Huber-Verlag.

Mensink GBM, 1999. Physical activity. *Ges-Wes* 61, pp 126-131.

Neuhann HF, Prätor K, Szemkus M, *et al.* 1992. PATIS – A Questionnaire-Based PC-Assisted Patient-Information-System in Environmental Medicine. *Zbl Hyg* 193, pp 350-363.

Seidel HJ. 2002. Environmental medicine in Germany – a review. *Environ Health Perspect* 110 suppl 1, 113-118.

Soine L, 1995. Sick building syndrome and gender bias: imperiling women's health. *Soc Work Health Care* 20, pp 51-65.

StBA (Statistisches Bundesamt [Statistical Federal Office]), 1997. *Stand und Entwicklung der Erwerbstätigkeit (Ergebnisse des Mikrozensus).* Stuttgart: Metzler-Poeschel.

StBA (Statistisches Bundesamt [Statistical Federal Office]), 1998. *Im Blickpunkt: Frauen in Deutschland.* Stuttgart: Metzler-Poeschel.

Stenberg B, Eriksson N, Hoog J, et al. 1994. The Sick Building Syndrome (SBS) in office workers. A case-referent study of personal, psychosocial and building-related risk indicators. *Int J Epidemiol* 23, pp 1190-1197.

Stopper H, and Gertler M, 2002. Physikalische Umwelt und Gesundheit. In *Geschlecht, Gesundheit und Krankheit*, Hurrelmann K, and Kolip P, eds. Bern, Göttingen, Toronto, Seattle: Verlag Hans Huber.

Wiesmüller GA, Weishoff-Houben M, Brölsch O, *et al.*, 2002a. Environmental agents as cause of health disorders in children presented at an outpatient unit of environmental medicine. *Int J Hyg Environ Health* 205, pp 329-335.

Wiesmüller GA, Dott W, Erdmann S, et al. 2002b. Diagnostic algorithm for patients with environment-related health disorders. *Allergologie* 25, pp 513-521.