

RELATIVE HUMIDITY OF THE AIR AND OCULAR DISCOMFORT
IN A GROUP OF SUSCEPTIBLE OFFICE WORKERS

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Abstract

In a group of 60 office workers who were selected for experiencing frequent ocular discomfort (there were 15 contact lens wearers among them), the association between the relative humidity (RH) of the air and ocular discomfort was investigated. On 22 days over a one-year period questionnaires were completed by the experimental subjects at 11:00 am while at the same day RH and temperature were recorded. The analysis of 927 records showed a significant association of RH and ocular discomfort for the group of lens wearers, but not for non-lens wearers. In both groups ocular discomfort was strongly associated with perceived humidity of the air. Lens wearers tend to predict the actual value of the RH slightly better than non-lens wearers. It is concluded that ocular discomfort of lens wearers can be minimized if the RH of indoor air is kept at values above at least 40%.

Introduction

Several investigators report ocular complaints in groups of office workers, often accompanied by other types of discomfort (3,5). Up to 37% of study populations have been reported to experience ocular discomfort. Office workers themselves mention dry air as a source of ocular discomfort, and this seems plausible assuming that the rate of evaporation from the tear film, which is inversely related to RH, influences irritation of the eyes. The association between RH and ocular discomfort has been investigated at extremely low values of RH in aeroplanes flying at high altitudes (1,2). In our company, a survey study was started after a group of contact lens wearers complained of ocular discomfort allegedly caused by a dry indoor climate (4). In that study among 669 clerical workers in a large office building, 50 to 75% of the contact lens wearers and 25% of those with glasses or without optical correction reported weekly or daily ocular discomfort. From that study persons experiencing frequent discomfort were selected to serve as subjects in the present study. The purpose of this study is to investigate to what extent variation in RH influences ocular discomfort.

Methods

From the survey investigation 91 persons were selected who reported weekly or daily ocular discomfort. There were 23 lens wearers among them. They were requested in writing to cooperate in the follow-up investigation on ocular discomfort and climatic factors. As smoking was prohibited in the offices there was no need to take this factor into account in the design of the study.

The subjects in the experimental group were all employed on 3 floors of a six storey building housing offices of a banking institution. The typically open offices were modern and spacious and on each floor approximately 100 people were working on an area of 1260 m². The clerical activities included mainly working at a desk, and some use of VDU's and microfiche readers. The building was equipped with an airconditioning system for heating, humidifying and cooling.

Although the conditions of outdoor air restrict the possible values of indoor RH, manipulation of indoor RH was achieved to a certain extent via control of the waterpumps in the humidifying section. In this way, on many days a RH could be obtained which fitted in our experimental design. RH and temperature were measured near seven clusters of desks on the three floors. The readings were recorded by the technical staff and were not accessible to office workers. The transducers were checked for bias with a Heat Stress and Comfort Analyser (TCR Tecora).

In order to rule out possible other causes of ocular discomfort formaldehyde and aerosol concentrations were measured. The efficiency of ventilation was assessed by measuring CO₂ concentrations. These factors were well within acceptable values.

The questionnaire on ocular discomfort was preceded by a short introduction, stressing that feelings of (dis)comfort at the time of completion of the questionnaire should be reported.

The first question asked about ocular discomfort. If positive, 4 subsequent questions asked about specific aspects of discomfort (burning eyes, watering eyes, itching eyes and dry eyes). Each of these had to be scored on a 6 point scale (no discomfort = 1, very serious discomfort = 6).

All respondents scored perceived humidity of the air on a 5 point scale (too dry = 1, too humid = 5). Finally everyone was asked whether contact lenses, glasses, or no correction were worn that particular morning. The decision when to organize an experimental day was made jointly by the technical staff and the occupational physician. The technical staff would either or not manipulate the RH at the start of the working day and the subjects were asked at 11:00 to complete the questionnaire.

Results

During the investigation period, from January 1986 to January 1987, questionnaires were completed and climatic data were recorded on 22 days. One or more completed questionnaires were obtained from 70 experimental subjects. Ten subjects were excluded from the analysis because they returned their questionnaires on less than 7 out of the 22 days. For analysis 927 questionnaires remained, i.e. 15.45 per subject. Sick leave, a day off, or not being at one's desk at 11:00 am for some

other reason, accounted for non-response.

RH values on experimental days are plotted in figure 1. These range from 20 to 60%.

For each subject, the mean value of RH was computed for those days on which he/she completed a questionnaire. All of these mean values fell within the interval $42 \pm 3\%$. This implies that no subjects selected particularly humid or dry days to complete their questionnaires. Therefore the responses per experimental day may be considered as a random sample from the population under investigation.

The recorded values of RH were corrected by means of regression lines calculated for each RH transducer from control measurements. Correlation coefficients, calculated per transducer, between obtained values and control measurements, ranged from 0.949 to 0.994. Temperature recordings were corrected with a constant term per transducer. Of the thus corrected values 96% fell within the interval $22.0 \pm 1.5^\circ\text{C}$ (median: 21.9°C). In the analysis the range of RH values was divided into 4 categories: 20 to 30%, 30 to 40%, 40 to 50% and 50 to 60%.

The highest of the scores on the four aspects of ocular discomfort was used as a measure of ocular discomfort for a person on a particular day.

In figure 2 the percentage of subjects experiencing ocular discomfort is plotted against categories of RH, separately for lens wearers and non-lens wearers.

The association between RH and discomfort for the group of lens wearers is clear, especially for moderate and considerable discomfort. This association has been tested in a 3×4 table and proved to be significant (chisquare = 16.52, $p = 0.011$). Non-lens wearers show a much weaker association or none at all (chisquare = 3.10, $p = 0.796$, also in a 3×4 table).

In figure 3 the percentage of subjects experiencing ocular discomfort is plotted against perceived humidity of the air. Because the numbers of observations in the category "too humid" (score = 5) were very low, this category has been combined with "humid" (score = 4).

Both for lens wearers and for non-lens wearers a strong association is present between the percentage of discomfort and categories of perceived humidity from "too dry" to "good" (lens wearers: chisquare = 64.56 and non-lens wearers: chisquare = 129.40, both $p < 0.001$).

In table 1 mean RH values are shown for each category of perceived humidity. For both groups the range of the mean values is small and the differences between them are not significant. Lens wearers seem to differentiate somewhat more than non-lens wearers.

Table 1: Mean values of actual RH for categories of perceived humidity

Perceived humidity	lens wearers			non-lens wearers		
	mean	standard error of the mean	N	mean	standard error of the mean	N
Too dry	40.2	36.9 - 43.6	49	41.9	40.2 - 43.6	167
Dry	44.3	42.2 - 46.3	118	43.1	41.6 - 44.5	273
Just right	45.5	42.7 - 48.3	51	44.8	43.3 - 46.3	211
Humid	40.7	-	3	40.6	31.7 - 49.5	10

Conclusion

Contact lens wearers are more susceptible to variations in RH than non-lens wearers as far as ocular discomfort is concerned. Discomfort is experienced particularly at RH values of 40% and less. For non-lens wearers the association between these two variables could not be confirmed. Both groups show a strong association between ocular discomfort and perceived humidity of the air. In both groups, no significant association exists between actual RH and perceived humidity of the air. Lens wearers differentiate somewhat better than non-lens wearers as shown by the ranges of mean RH values in table 1. It is recommended that RH be kept at least at 40% in order to minimize ocular discomfort in contact lens wearers.

References

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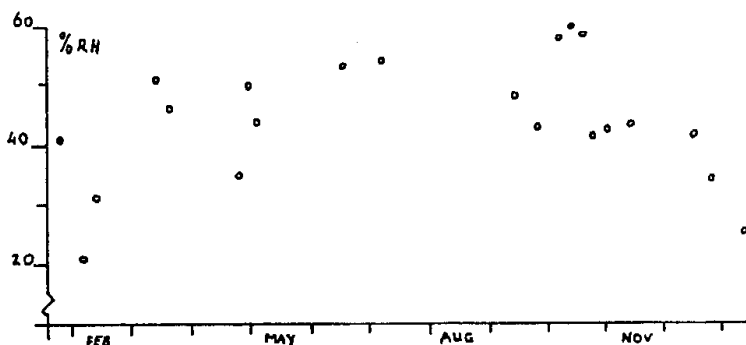


Fig. 1. Values of RH measured on experimental days on one of the floors.

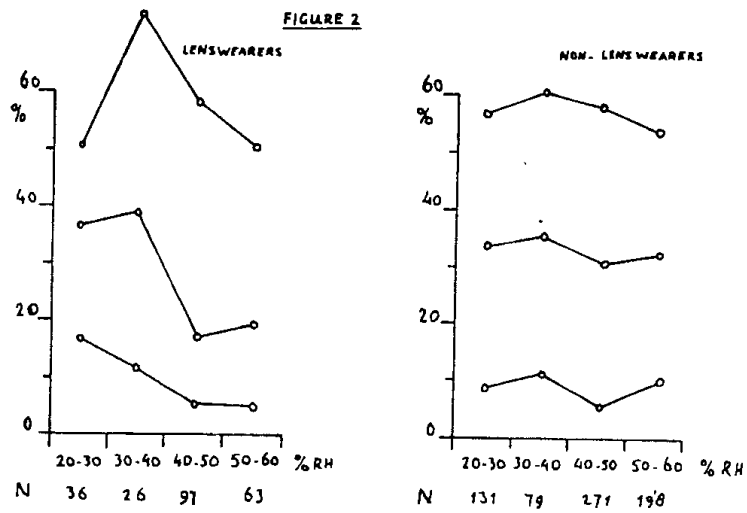


Fig. 2. Percentage of population reporting ocular discomfort (y-axis) and category of RH (x-axis).
 line a: slight discomfort (score 2 or more)
 line b: moderate discomfort (score 3 or more)
 line c: considerable discomfort (score 4 or more)
 Number of cases in each category are shown.

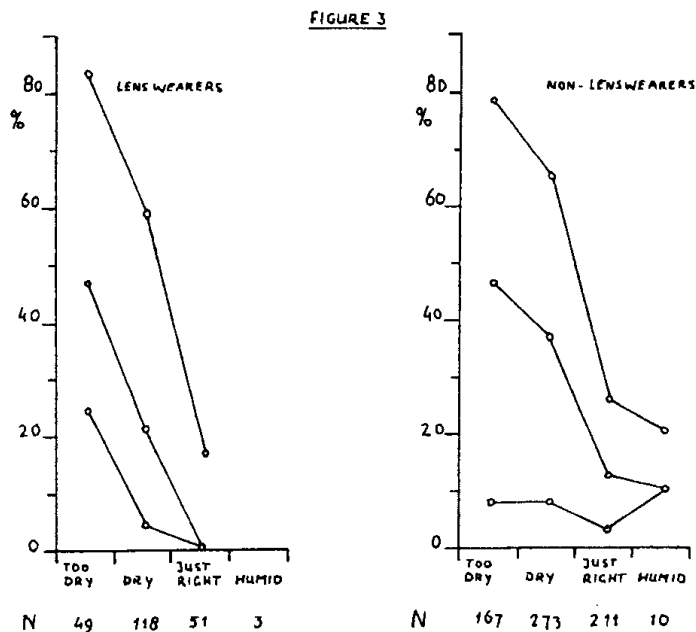


Fig. 3. Percentage of population reporting ocular discomfort (y-axis) and perceived humidity of the air (x-axis).
 Line a, b, c as in figure 2.