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### Effects of air temperature, humidity and lighting on workers' comfort and health in call centre department

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#### A B S T R A C T

A call centre is a centralized office used for the purpose of receiving and transmitting a large volume of requests by telephone. The major contributors to job stress are poor environments due to temperature, humidity and lighting. This research is to determine the effects of air temperature, humidity and lighting between genders and ages among workers. These data were combined to estimate the exposure level by using statistical analysis. 30 measurements were taken at 10 different locations during 9.00 a.m, 12.00 p.m and 5.00 p.m. 40 respondents participated in the survey conducted to identify the exposure and symptoms or other health related problems among the workers. The study indicated that the mean value recorded for temperature at 9.00 a.m was 25.4°C, for temperature at 12.00 p.m was 23.8°C and mean for temperature at 5.00 p.m was 23.4°C. While for humidity, the mean value for humidity at 9.00 a.m is 58.98 (RH %), at 12.00 p.m is 57.84 (RH %) and the last reading which is for humidity at 5 pm is 60.20 (RH %). The mean value for the lighting is 278.9 lux during 9.00 a.m and 282.7 lux for the mean at 12.00 p.m and mean results during 5.00 p.m shows 280.4 lux. The findings indicated that there is no significant difference between gender and ages towards the effect of the temperature, humidity and lighting on the workers' health.

### Introduction

Thermal comfort describes a person's state of mind in terms of whether they feel too hot or too cold. It is defined as 'that condition of mind which expresses satisfaction with the thermal environment.' Environmental factors

(such as humidity and sources of heat in the workplace) combine with personal factors (such as clothing and how physically demanding the work is) to influence what is called 'thermal comfort' (1).

Thermal environment may contribute to the overall health and well-being of the employee and the well-being of the organization. Poorly managed thermal environment may cause absenteeism, turnover of staff and complaints. If a person's thermally comfortable this can increase employee motivation, productivity and quality of output. The best that can realistically be hoped to be achieved is a thermal environment that satisfies the majority of people in the workplace or put more simply 'reasonable comfort' should be achieved. HSE consider that 80% of occupants could reasonably be expected to be thermally comfortable in a given environment (1).

A call centre or call center is a centralized office used for the purpose of receiving and transmitting a large volume of requests by telephone. It is operated by a company to administer incoming product support or information inquiries from consumers. Outgoing calls for telemarketing, clientele, product services, and debt collection are also made. In addition to a call centre, collective handling of letters, faxes, live chat, and e-mails at one location is known as a contact centre.

In Malaysia call centre is a fast growing industry; many people's are going to get involved in this industry. The aim of this research is to help all call centre industry stakeholders interpret the relevant regulations and guidance within the context of call centre working practices in order to protect the health and safety of those employed in the industry. Stakeholders include local authority enforcement officers, call centre managers, call centre health and safety officers, union and health and safety representatives, occupational health and human resources personnel and call centre employees.

## **Methodology**

This study was conducted with various sources of data and information collection such as through literature review, articles and also journal. Preliminary measurement of temperature, humidity and lighting exposure among the workers' or Customer Service Officer (CSO) was done at their workplace. Information are also gathered from the questionnaire given to the CSO in order to know their perceptions on the temperature, humidity and as well as lighting.

Standard procedure of gathering information Information on the following was gathered at the initial stage of this paper:

- (a) Effects of temperature to the human or workers'
- (b) Instruments and method used on measurement of temperature, humidity and lighting at the workplace
- (c) Recommended standard of exposure towards temperature, humidity and lighting at the workplace

## **Call centre department descriptions**

Call centre department which is located at Plaza Pantai in Jalan Pantai Baru Kuala Lumpur was selected as the survey location. It is a banking industry call centre where by everyday there are high volumes of calls needed to be entertained or answered by the CSO. The call centre department consists of 105 staffs which divided by two levels which are at level 9 and level 10. Only 78 of the staffs answer the calls while the others are from supports and administration teams. The normal working hours can be divided into three working hours or groups. For the workers' who started their work at 8 am they will finished at 5 pm, while for those who started at 9.00 a.m will finished at 6.00 p.m

and those who started at 10.00 a.m will be finishing at 7.00 p.m.

### **Instruments**

There are two instruments that are use in this research which is temperature and humidity meter and, lux meter. Humidity meter is used to measure the temperature and humidity of the environment. The readings were taken in three different times which is at 9.00 a.m, 12.00 p.m and 5.00 p.m. The measurement of lighting where by lux meter is the instrument used to measure the lighting.

### **Measurement**

The parameters of thermal and luminous were measured concurrently in this study. Air temperature was measured using humidity meter as well as humidity measurement. A precision lux meter was employed to measure the luminance or lighting of the workplace in the study department. Identification of luminance levels is essential in environment comfort studies. In this study, natural daylight is available and being applied in the workplace that is near the windows.

Therefore, a lux meter was applied as it is a suitable apparatus or instrument in checking and measurement of luminance level. The field study was conducted in three different times which is at 9.00 a.m, 12.00 p.m and 5.00 p.m for each location or spot. In each different time, 10 readings or measurements were taken at different location. This was done to get a variation measurement in term of temperature, humidity and lighting at different times.

### **The questionnaires**

To gain workers' perceptions of environmental comfort, subjective

assessment which applying questionnaire surveys were performed. Questionnaires were given to 78 of respondents by their respective supervisors. In early sections of the questionnaire, test subjects were required to note down or tick their respective demographics which included gender, age and their status. The questionnaire consists of several sections, where the first part is the subjective ratings on a variety of thermal scales such as temperatures, air quality, humidity and lighting and also questions of human preferences towards thermal comfort. In addition, the effect of thermal sensation towards work productivity of the works in the call centre department was investigated in the field survey. The following parts of the questionnaire require participants to note down their perceptions on temperature, humidity and lighting and possible effect on their health and also work performance in the office. The questionnaire are taken from Second Edition, Ergonomics-How to Design for Ease and Efficiency book (2).

This survey has two particularly important objectives which are to investigate or describe the effects of air temperature in call centre on the workers health and to describe the perceptions on the effects of temperature, humidity and lighting between gender and ages. The information required at this point includes the number of exposed worker.

### **Data analysis**

Statistical tools, SPSS 19.0 were used to analyze the measurements and survey data. The descriptive statistics were generated for the measurement of the temperature, humidity and lighting at 9.00 a.m, 12.00 p.m and also 5.00 p.m. Besides that, T-test was conducted to determine if mean temperature, humidity and lighting between certain variables such as spot and time had

statistically significant differences. The P-values which is less than 0.05 were considered statistically significant. 3

## **Results**

### **Temperature measurement**

A total of 30 temperature measurements were taken at 10 different locations at the workplace in the call centre department. The locations are selected randomly. The differences in temperature readings recorded during these measurements are described in Table 1. The mean value recorded for temperature at 9 am was 25.4°C, for temperature at 12 pm was 23.8°C and mean for temperature at 5.00 p.m was 23.4°C. In the result stated that the maximum temperature value was during 9.00 a.m while the minimum value was during 12.00 p.m. The correlation for the relations the temperature at 9.00 a.m and 12.00 p.m was carried out. The result indicated that the relationship between the two variables is not significant. The relation of temperature at 12.00 p.m and 5.00 p.m is also not significant.

### **Humidity measurement**

As for humidity, a total of 30 temperature measurements were also taken at 10 different locations at the workplace in the call centre department. Table 2 shows that the maximum humidity reading is at 9.00 am for the value of 61.00 (RH %) while the minimum reading is at 12.00 p.m with the value of 60.10 (RH %). Mean value for humidity at 9.00 a.m is 58.98 (RH %), at 12.00 p.m is 57.84 (RH %) and the last reading which is for humidity at 5.00 p.m is 60.20 (RH %).

### **Lighting measurement**

A total of 30 measurements were collected at different spots or locations in the call centre department. 10 measurements respectively were taken during 9.00 a.m, 12.00 p.m and 5.00 p.m. Table 3 shows the result of the lighting measurement conducted. The results indicated that the maximum reading is 480.0 lux at 12.00 p.m and the minimum reading is during 9.00 a.m for value of 471.0 lux. The mean value for the illuminance is 278.9 lux during 9.00 a.m and 282.7 lux during 12.00 p.m. Mean results during 5.00 p.m show 280.4 lux.

### **Survey results**

There were 78 of CSO working at the call centre department and they were divided into three normal working hours which is; 8.00 am to 5.00 pm, 9.00 am to 6.00 pm and 10.00 am to 7.00 pm. 40 out of 78 CSO responded to the questionnaire. 62.5% (25) of respondents are female and 37.5% (15) of respondents are male. None of the female respondents are pregnant during the survey. Almost 75% (30) of the respondents are between 20-30 years where the rests 25% (10) are between 30-40 years old. There are no respondents with the age of 40 years and above involved in the survey conducted. Out of 40 respondents, 72% (29) are single meanwhile 28% (11) are married.

From the survey conducted, almost half of the respondents 55% (22) are being working for more than two years in the call centre department. 30% (12) of them worked as CSO for one to two years and only 15% (6) respondents worked for less than one year.

**Table.1** Temperature measurement at 9.00 a.m, 12.00 p.m and 5.00 p.m Time

	Range [°C]	Minimum [°C]	Maximum [°C]	Mean [°C]	Std. Deviation
At 9.00 a.m	2.1	23.3	25.4	25.4	0.6977
At 12.00 p.m	2.7	21.1	23.8	23.8	0.8769
At 5.00 p.m	1.6	21.8	23.4	23.4	0.5051

**Table.2** Humidity measurement at 9.00 a.m, 12.00 p.m and 5.00 p.m Time

	Range [%]	Minimum [%]	Maximum [%]	Mean [%]	Std. Deviation
At 9.00 a.m	3.60	57.40	61.00	58.98	1.1153
At 12.00 p.m	4.50	55.60	60.10	57.84	1.4767
At 5.00 p.m	2.60	57.60	60.20	58.64	0.800

**Table.3** Lighting measurement at 9.00 a.m, 12.00 p.m and 5.00 p.m Time

	Range [lux]	Minimum [lux]	Maximum [lux]	Mean [lux]	Std. Deviation
At 9.00 a.m	316.0	155.0	471.0	278.9	81.7917
At 12.00 p.m	280.0	200.0	480.0	282.7	78.7867
At 5.00 p.m	278.0	198.0	476.0	280.4	77.9689

**Table.4** Significances on negative affect towards work performance due to temperature

	Not significant at all [1]	Slightly not significant [2]	Not significant [3]	Significant [4]	Slightly significant [5]	Very significant [6]
Number of Respondents	4	6	8	4	14	4

**Table.5** Example of effect on health experience by the respondents' Examples

	Number of respondents
Encounter tiredness at work	12
Throat, coughing and irritation	23
Dryness	17
Headaches	15
Numbness	3
Drowsiness	5
Eye irritation	9
Others	2

The result of percentile of CSO base on durations of workings indicated that 57.5% (23) of CSO allocate more than 8 hours at the office, 40% (16) respondents allocate 7 to 8 hours and only 2.5% (1) allocate 5 to 6 hours at the office. Most of the respondents which is 57.5% (23) indicated that they had spends 7 to 8 hours at visual display unit (VDU), 30% (12) spends more than 8 hours while 12.5% (5) spend about 5 to 6 hours at VDU. Although most of the respondents spend more than 8 hours at the office, majority of them only spends 7 to 8 hours at the VDU for example their computer.

Table 4 shows the results of the negative affect towards work performance due to temperature. 14 out of 40 respondents indicated that as slightly significant while only 4 respondents mentioned that temperature does not give any negative effects on their work performance.

From the questionnaire given, the scale 1 until 6 indicated whether the temperature in the office is too cold or too warm. Scale 1 referring to temperature that is too cold and scale 6 for too warm. Majority of the respondents 37.5% (15) mentioned that the temperature in the office is quit cold with the scale of 5. None of the respondents mentioned that the temperature in the office is too warm during the survey. Most of the respondents which is 27.5% (11) indicated that the air qualities in the office have given a negative affect on their work performance. 15% (6) mentioned it is not significant at all while only 2.5% (1) indicated it as very significant. 35% (14) of the respondents said that the humidity of the workplace is significantly affected by the external weather conditions. 15% (6) respondents mentioned it as not significant at all and slightly not significant while no respondents mentioned it as very significant.

Most of the respondents which is 37.5% (15) indicated that the light in the department significantly have a negative affect on their performance. 2.5% (1) said that it is very significant and 12.5% (5) said that it is not significant at all. Most of the respondents 62.5% (25) respond that only little natural light in the office. 2.5% (1) indicated as too little, 10% (4) indicated as slightly little and no one indicate it as too much of natural light. More than 42.5% (17) respondents said that there is much of artificial light at the office, 25% (10) indicated as little, 20% (8) respondents perceived that it is slightly little artificial light provided and 7.5% (3) said that it is too little artificial light provided. 2.5% (1) respondents perceived that the artificial light is slightly much and too much respectively. 72.5% (29) of the respondents mentioned that temperature, humidity and lighting have given an effect on their health and work performance while 27.5% (11) informed that temperature, humidity and lighting did not give any effect on their performance and health.

Those who responded that temperature, humidity and light have given an effect on their health had indicated the examples of the effects that they experience. From the result, we can indicate that most of the respondents which is 23 out of 29 respondents who answer yes had experience throat, coughing and irritation. 17 respondents had undergone dryness, 15 of them had headaches, and 12 out of 29 respondents had encounter tiredness at work that may have also affected their work performance. Other than that, 9 of the respondents had experience eye irritation, 5 mentioned that they always had drowsiness, 3 for numbness and 2 respondents responded as other reasons as shown in Table 5. Other resources that reported by the respondents are coldness and flu.

From the survey conducted, the results indicated that there is no significant difference between gender and ages towards the effect of the temperature, humidity and lighting on the workers' health. Each of the workers' or CSO experience different symptoms such as dryness, headaches, numbness and drowsiness but both genders also encounter the same problems. Results from the survey indicated that the workers from level 9 and level 10 experiences same symptoms and problems.

## **Discussion**

### **Temperature, humidity and lighting measurement**

Hot working conditions affected by the increasing temperature and also ventilations. Whether the conditions of the workplace are too cold or too hot, it will affect the efficiency and quality of the work. The results indicated that the temperature is decrease from 25.4°C at 9.00 a.m, 23.8°C at 12.00 p.m and 23.4°C at 5.00 p.m. Previous study had indicated that the healthy or suitable room temperature is between 180C to 210C. The temperature which is above 24°C can increase the risk of getting stroke. Besides that, for the temperature which is below 16°C it may leads to the respiratory illness.

Humidity of the workplace or in the call centre department also may give direct affect the health and work performance of the workers'. As for this finding, the percentage value of the humidity increase during 5.00 p.m which is 58.64 (RH%) with the temperature of 23.4°C. This is because, it is rainy day whereby it is started to rain at 4.00 p.m onwards when this measurement or reading is conducted and its effect the value of humidity especially for the workers that is near to the air-conditional or ventilation.

For most of us, the majority of our waking hours are during the day and daylight has a significant effect on how we see. Daylight also has a large impact on how much and what type of supplementary lighting we need. Two important parameters related to artificial lighting are efficiency (light output per unit energy; typically lumens/watt) and colour rendering. Efficiency is particularly important since it is related to cost; efficient light sources reduce energy consumption.

From the results, the illuminance reading or measurement had increase to 282.70 at 12.00 p.m due to the existent of the natural light. Before that, at 9.00 a.m the measurement is only 278.9 which show that inadequate light occur in the workstation. This situation will cause eyestrain, eye irritation and headaches to the workers at the work place. The luminance factor in a building could have significant effect on human comfort, although it is not as easily sensed by the occupants as compared to thermal conditions. Referring to field survey performed by Steward (1981), visual comfort may have certain level of influence towards general comfort of students and amount of daylight as a possible influence upon behavior was notified (3).

### **Survey on environmental perception**

Data collection shows that most of the workers had experiences coldness in the workplace due to cold temperature especially during the rainy day. It leads to the symptoms of throat, coughing, irritation, encounter tiredness at work, dryness, drowsiness, numbness and also eye irritation. From the results, it shows that the all the symptoms give an effect for both genders which is male and female. This finding is supported by Laurance S. Kalkstein and Kathleen M. Valimont (1998) in their study of climate effects on human

health. Some studies contend that the difference in the response of men and women to cold is related to the amount of subcutaneous fat within the body but other studies have failed to confirm this hypothesis.

## **Conclusions**

From the results of the study, it can be concluded that:

(a) 72.5% of the workers in the call centre department appear to have substantial over exposure to temperature, humidity and light.. Despite the overexposure to temperature, humidity and health will affect the health and had disturbed the task of the workers.

(b) A proper working environment is important not only from the standpoint of increasing productivity and improving the physical health and safety of the workers, but also for promoting workers morale and consequent reductions in worker absenteeism and workers turnover.

Lighting at work is very important to the health and safety of everyone using the workplace. Poor lighting cannot only affect the health of people at work causing symptoms like eyestrain, migraine and headaches but is also linked to sick building syndrome (4).

## **Ethical considerations**

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy etc have been completely observed by the authors.

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