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Impact of Lighting in Retail Cloth Stores on Salesperson Blood Pressure, Heart Rate and Body Temperature

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Abstract: A major challenge in recent times in the illumination field has been to define how light affects health, not only in aspects related to work but also related to human health and performance. The aim of the study was to explore the impact of lighting on salesperson blood pressure, heart rate and body temperature in retail cloth stores. For the study, ten retail cloth stores were selected in Hyderabad and Secunderabad, the twin cities of Andhra Pradesh. The study was conducted on 100 salesperson who were working in these retail cloth stores. This information was recorded with scientific instrument before starting, during and after the work and the results showed that the lighting condition in the retail cloth stores had shown an impact on salesperson blood pressure and body temperature whereas had not shown any impact of salesperson heart rate bright lighting played a significant role on the salesperson health.

Keywords: Lighting factors, blood pressure, heart rate and body temperature

1. Introduction

Lighting as a health hazard. Lighting is a critical tool in human functioning. It allows human being to see things and perform activities. Light entering the human eyes has an important non-visual biological effect on the human body, influences human health, well-being and productivity at the work environment. Lighting as an art element plays a major role in aesthetics of a building design. But it is also important because it affects human being psychologically and physiologically **(Manav and Yener, 1999).**

Kakooei et al. (2010) found that the effect of bright light on body temperature of shift work nurses were increased where as **Ruger et al. (2005)** revealed that bright light increased heart rate and core body temperature during the night time exposure only but not during daytime exposure. **Tsunodo et al. (2001)** revealed that there was a significant increase in heart rate by exposing either to bright lights (10,000 lux) or to extreme darkness (<0.01 lux), while high and low frequency of heart rate variability were nor changed when compared with those under dim light (100 lux). **Badia et al. (1991)** found that there was no differential effect on body temperature between bright light and dim light during the daytime exposure. The purpose of the study is to find out the impact of lighting in retail cloth stores on salesperson blood pressure, heart rate and body temperature.

2. Methodology

2.1 Sampling procedure

Exploratory research design was selected for this study. From each store, the list of ten salesperson was selected before and after starting the work and demographic characteristics by using an interview schedule. The researcher conducted a study with a sample size of 100 salesperson of different age groups randomly selected in retail cloth stores of Hyderabad and Secunderabad, the twin cities of Andhra Pradesh for investigating the effect of lighting parameters in retail cloth stores on salesperson blood pressure, heart rate and body temperature.

2.2 Variables and their measurement

The independent variables of the study were age of the worker, number of years of work experience and quantity of lighting parameters in retail cloth stores. The dependent variables selected for the study were blood pressure, heart rate and body temperature. In the present investigation the quantity of illumination in retail cloth stores was taken as a base for understanding the differences among retail cloth store. According to **United States environmental protection agency (1997)**, the quantitative parameters of illumination are luminous flux (lm), illuminance (lux), luminance (cd/m^2). Hence these lighting parameters were taken as independent variables. These parameters were measured on floor, ceiling, backside of the consumer seating (wall 1), left hand side of the consumer seating (wall 2), wall facing the consumer seating (wall 3) and right hand side of the consumer seating (wall 4).

Table 1: Distribution of sample by blood pressure before work, during work and after work

Blood pressure	*Below normal (90/60)*	*Normal (120/80)*	*Above normal (140/90)*	*Total*
Before work (%)	21	58	21	100
During work (%)	19	60	21	100
After work (%)	6	76	18	100

2.3 Tools used

Blood pressure, Heart rate and Body temperature were measured by using blood pressure monitor, heart rate monitor and thermometer.

2.4 Data Analysis

Frequencies and percentages were calculated for the profile of the respondents on the variables. The four outcome groups based on the similarities of lighting conditions were treated as independent variables for data analysis. The data was subjected ANOVA, to find out the association between independent and dependent variables of the study. The data collected on salesperson blood pressure, heart rate and body temperature was tabulated, presented and discussed below. Hypothesis was formulated to test the relationship between independent and dependent variables.

3. Results and Discussion

3.1 Demographic Data

The participants for the study were mostly middle aged persons, aged 34.04 ± 8.96 years (mean ± SD). Years of work experience of the selected salesperson ranged from 2-35 years. Comparatively, a larger proportion (38%) of the sample bared a work experience of 6-15 years. Twenty eight per cent of the sample had > 16 years of experience as salesperson.

3.2 Blood pressure

Blood pressure of the respondent before starting the work in the morning was recorded and categorized as below blood pressure, normal blood pressure and above blood pressure, based on the readings. 120/80 was considered as normal blood pressure level. 90/60 was considered as below normal blood pressure and 140/90 was considered as above normal blood pressure level (Struijk et al., 2008).

Before starting the work, fifty eight per cent of the samples had normal blood pressure i.e., 120/80 whereas equal proportion (21%) of the sample had high and low level of blood pressure (Table 1).

During the work, sixty per cent of the sample had normal blood pressure where as 21 per cent of the sample had high blood pressure and the remaining 19 per cent of the sample had low blood pressure (Table 1).

After the work, three fourth per cent of the sample had normal blood pressure whereas 18 per cent of the sample had high blood pressure and the remaining 6 per cent of the sample had low blood pressure after the work is over (Table 1).

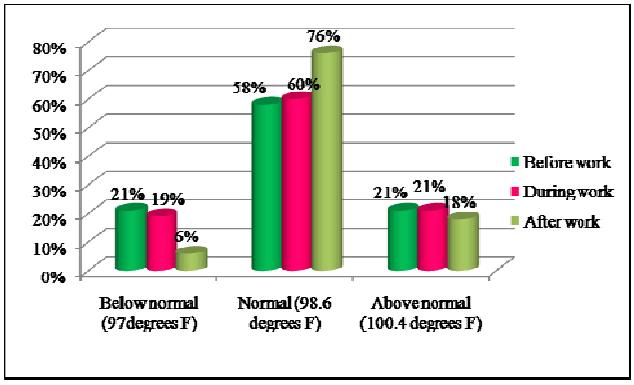

Figure 1: Comparison of blood pressure before work, during work and after work

From the Figure 1, it was observed that there was a decrease in below and above normal blood pressure level from before work to during work and from during work to after work and there was an increase in normal blood pressure level from before work to during work and from during work to after work.

3.2.1 ANOVA among groups in blood pressure before work with regard to lighting effect

According to lighting factors the retail cloth stores were significantly classified into four groups. According to blood pressure before work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be significant at 0.05 level (Table 2).

Table 2: Analysis of variation among groups in blood pressure before work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	3.68*	0.0148	0.05
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

3.2.2 Mean comparison and significant probabilities between the scores of different groups in blood pressure before work with regard to lighting effect

For further study pairs of groups were tested at 1 per cent level of significance by using 't'-test (Multiple Comparison Test). Computed 't' values revealed significant difference between group 1 and 3 at 0.01 level and between group 3 and 4 at 0.01 level (Table 3).

Table 5. Mean comparisons and significant probabilities between the scores of different groups in blood pressure before work with regard to lighting effect

Effect	Group	_Group	Estimate	Standard Error	DF	t-Value	Probability >|t| value	Level of significance
Group	1	2	7.7	4.7502	96	1.62^{NS}	0.1083	NS
Group	1	3	14.75	5.2036	96	2.83**	0.0056	0.01
Group	1	4	1.3	4.7502	96	0.27^{NS}	0.7849	NS
Group	2	3	7.05	4.7502	96	1.48^{NS}	0.141	NS
Group	2	4	-6.4	4.2487	96	-1.51^{NS}	0.1353	NS
Group	3	4	-13.45	4.7502	96	-2.83**	0.0056	0.01

** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant

Hence, the null hypothesis was rejected.

There exists a relationship between lighting conditions in retail cloth stores and the blood pressure of worker before starting the work.

3.2.3 ANOVA among groups in blood pressure during work with regard to lighting effect

According to blood pressure during work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be significant at 0.05 level (Table 4).

Table 4: Analysis of variation among groups in blood pressure during work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	2.75*	0.0471	0.05
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

3.2.4 Mean comparison and significant probabilities between the scores of different groups in blood pressure during work with regard to lighting effect

For further study pairs of groups were tested at 1 per cent level of significance by using 't'-test (Multiple Comparison Test). Computed 't' values revealed significant difference between group 3 and 4 at 0.01 level (Table 5).

Table 5. Mean comparisons and significant probabilities between the scores of different groups in blood pressure during work with regard to lighting effect

Effect	Group	_Group	Estimate	Standard Error	DF	t-Value	Probability >|t| value	Level of significance
Group	1	2	-0.2333	4.856	96	-0.05^{NS}	0.9618	NS
Group	1	3	5.9	5.3194	96	1.11^{NS}	0.2701	NS
Group	1	4	-7.7	4.856	96	-1.59^{NS}	0.1161	NS
Group	2	3	6.1333	4.856	96	1.26^{NS}	0.2096	NS
Group	2	4	-7.4667	4.3493	96	-1.72^{NS}	0.0888	NS
Group	3	4	-13.6	4.856	96	-2.80**	0.0062	0.01

**- significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant

Hence, the null hypothesis was rejected.

There exists a relationship between lighting conditions in retail cloth stores and the blood pressure of worker during work.

3.2.5 ANOVA among groups in blood pressure after work with regard to lighting effect

According to blood pressure after work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be non significant (Table 6)

Table 6: Analysis of variation among groups in blood pressure after work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	2.38^{NS}	0.0740	NS
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

Hence, the null hypothesis was accepted.

There exists no relationship between lighting conditions in retail cloth stores and the blood pressure of worker after the work is over. According to the present study lighting conditions in retail cloth stores had an impact on salesperson blood pressure before starting the work and during work. However lighting conditions in workplace had shown no impact on blood pressure after the work.

3.3 Heart rate level

Heart rate level before starting, during and after the work was recorded and each one was treated as a separate variable. 60-100 beats per minute was considered as normal heart rate. Below 60 beats per minute was considered as low level of heart rate and above 100 beats per minute was considered as high heart rate (Kolata, 2001).

Table 7: Distribution of sample by heart rate before work, during work and after work

Heart rate	Below normal 60bpm	Normal 60-100 bpm	Above normal 100	Total
Before work (%)	19	68	13	100
During work (%)	10	79	11	100
After work (%)	8	82	1o	100

From the Table, it was revealed that before starting the work, sixty eight per cent of the sample had normal heart rate i.e., 60-100 beats per minute whereas 19 per cent of the sample had below 60 beats per minute. Thirteen per cent of the samples had above 100 beats per minute (Table 7).

During the work, more than three-fourth of the sample (79%) had normal heart rate where as 11 per cent of the sample had high heart rate and the remaining 10 per cent of the sample had low heart rate (Table 7).

After starting the work, 82 per cent of the sample had normal heart rate whereas 10 per cent of the sample had high heart rate and the remaining 8 per cent of the sample had low heart rate levels (Table 7).

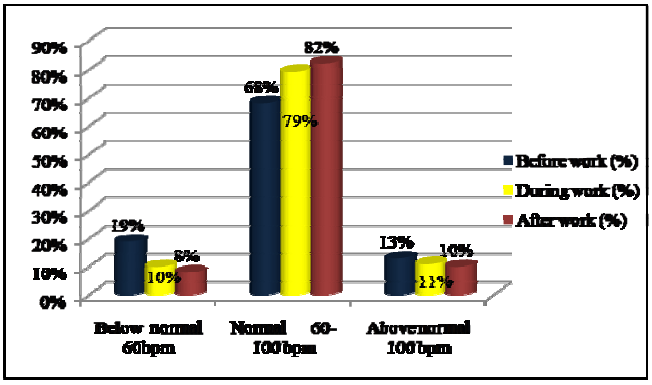

Figure 2: Comparison of heart rate level before work, during work and after work

From the Figure 2, it was observed that there was a decrease in below and above normal heart rate beat from before work to during work and from during work to after work and there was an increase in normal heart rate beat from before work to during work and from during work to after work According to the present investigation work had shown an impact on heart rate beat of salesperson during work..

3.3.1 ANOVA among groups in heart rate before work with regard to lighting effect

According to heart rate before work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be non significant (Table 8).

Table 8: Analysis of variation among groups in heart rate before work with regard to lighting effect

Effect	Within groups	Between groups	F – Value	Probability F-Value	Level of significance
Group	3	96	0.44NS	0.7227	NS
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

Hence, the null hypothesis was accepted.

There exists no relationship between lighting conditions in retail cloth stores and the heart rate of worker before starting the work.

3.3.2 ANOVA among groups in heart rate during work with regard to lighting effect

According to heart rate during work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be non significant (Table 9).

Table 9: Analysis of variation among groups in heart rate during work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	1.69^{NS}	0.1742	NS
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

Hence, the null hypothesis was accepted.

There exists no relationship between lighting conditions in retail cloth stores and heart rate of the worker during the work.

3.3.3 ANOVA among groups in heart rate after work with regard to lighting effect

According to heart rate after work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be non significant (Table 10).

Table 10: Analysis of variation among groups in heart rate after work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	0.17^{NS}	0.919	NS
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

Hence, the null hypothesis was accepted.

There exists no relationship between lighting conditions in retail cloth stores and heart rate of the worker after the work. According to the study illuminated work environment had not shown any impact on salesperson heart rate before work, during work and after work.

3.4 Body temperature

Body temperature of the subject was measured by using digital thermometer. 98.6^0F was considered as normal body temperature. Below 97^0F was considered as low level of body temperature and above 100.4^0F was considered as high body temperature (Kelly, 2007). Body temperature before starting the work, during the work and after the work was recorded and each one was treated as a separate variable.

Table 11: Distribution of sample by body temperature before work, during work and after work

Body temperature	Below normal (97^0F)	Normal (98.6^0F)	Above normal (100.4^0F)	Total
Before work (%)	21	68	11	100
During work (%)	19	62	19	100
After work (%)	16	66	18	100

Based on the readings, before starting the work sixty eight per cent of the samples were found with normal body temperature. One-fifth of the sample (21%) had low body temperature. The remaining 11 per cent of the sample had high body temperature (Table 11).

During the work, Sixty two per cent of the sample had normal body temperature while on work. Equal proportion of the sample had low (19%) and high (19%) body temperature (Table 11).

After the work, sixty six per cent of the samples had normal body temperature whereas 18 per cent of the sample had high body temperature and the remaining 16 per cent of the sample had low body temperature (Table 11).

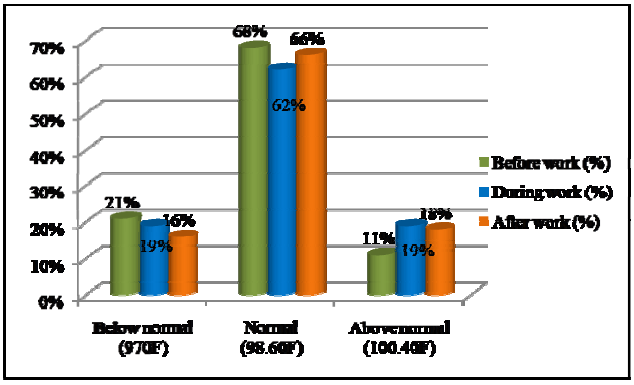

Figure 3: Comparison of body temperature before work, during work and after work

From the Figure 3, it was observed that there was a decrease in below normal body temperature from before work to during work and from during work to after work.

There was a decrease in normal body temperature from before work to during work and again increased from during work to after work

In above normal body temperature, there was an increase from before work to during worm and again it was decreased from during work to after work. According to the present investigation light had shown an impact on body temperature of salesperson during work and after work.

3.4.1 ANOVA among groups in body temperature before work with regard to lighting effect

According to body temperature before work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be significant at 0.01 level (Table 12).

Table 12: Analysis of variation among groups in body temperature before work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	4.82**	0.0036	0.01
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

3.4.2 Mean comparison and significant probabilities between the scores of different groups in body temperature before work with regard to lighting effect

For further study pairs of groups were tested at 1 per cent level of significance by using 't'-test (Multiple Comparison Test). Computed 't' values revealed significant difference between group 1 and 2 at 0.01 level and between group 1 and 4 at 0.01 level (Table 13).

Table 13. Mean comparision and significant probabilities between the scores of different groups in body temperature before work with regard to lighting effect

Effect	*Group*	*_Group*	*Estimate*	*Standard Error*	*D F*	*t-Value*	*Probability >t-value*	*Level of significance*
Group	1	2	1.425	0.4784	96	2.98**	0.0037	0.01
Group	1	3	0.815	0.5241	96	1.56NS	0.1232	NS
Group	1	4	1.6983	0.4784	96	3.55**	0.0006	0.01
Group	2	3	-0.61	0.4784	96	-1.27NS	0.2054	NS
Group	2	4	0.2733	0.4279	96	0.64NS	0.5245	NS
Group	3	4	0.8833	0.4784	96	1.85NS	0.0679	NS

**- significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant

Hence, the null hypothesis was rejected.

There exists a relationship between lighting conditions in retail cloth stores and the body temperature of worker before starting the work.

3.4.3 ANOVA among groups in body temperature during work with regard to lighting effect

According to body temperature during work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be significant at 0.01 level (Table 14).

Table 14: Analysis of variation among groups in body temperature during work with regard to lighting effect

Effect	Within groups	Between groups	F - Value	Probability F-Value	Level of significance
Group	3	96	6.20**	0.0007	0.01
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

3.4.4 Mean comparison and significant probabilities between the scores of different groups in body temperature during work with regard to lighting effect

For further study pairs of groups were tested at 1 per cent level of significance by using 't'-test (Multiple Comparison Test). Computed 't' values revealed significant difference between group 1 and 2 at 0.01 level and between group 1 and 4 at 0.01 level (Table 15).

Table 15. Mean comparision and significant probabilities between the scores of different groups in body temperature during work with regard to lighting effect

Effect	*Group*	*_Group*	*Estimate*	*Standard Error*	*D F*	*t-Value*	*Probability >t-value*	*Level of significance*
Group	1	2	1.39	0.3809	96	3.65**	0.0004	0.01
Group	1	3	0.765	0.4173	96	1.83NS	0.0698	NS
Group	1	4	1.4733	0.3809	96	3.87**	0.0002	0.01
Group	2	3	-0.625	0.3809	96	-1.64NS	0.1041	NS
Group	2	4	0.08333	0.3407	96	0.24NS	0.8073	NS
Group	3	4	0.7083	0.3809	96	1.86NS	0.066	NS

**- significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant

Hence, the null hypothesis was rejected.

There exists a relationship between lighting conditions in retail cloth stores and the body temperature of worker during work.

3.4.5 ANOVA among groups in body temperature after work with regard to lighting effect

According to body temperature after work, Analysis of variance was performed among groups of retail cloth stores. The 'F' value was found to be non significant (Table 16).

Table 16: Analysis of variation among groups in body temperature after work with regard to lighting effect

Effect	Within groups	Between groups	F – Value	Probability F-Value	Level of significance
Group	3	6	2.68 NS	0.0514	NS
** - significant at 0.01 level, *- significant at 0.05 level, NS – Non Significant					

Hence, the null hypothesis was accepted.

There exists no relationship between lighting conditions in retail cloth stores and body temperature of the worker after

the work. According to the present study lighting conditions in retail cloth stores had an impact on salesperson body temperature before starting the work and during work. However lighting conditions in workplace had shown no impact on body temperature after the work was over.

4. Conclusions

This study was taken up to explore that illuminated environment in retail cloth stores had shown an impact before starting and during the work on salesperson blood pressure and body temperature whereas after the work there was no impact on salesperson blood pressure and body temperature.

In case of heart rate illuminated work environment had not shown any impact on salesperson heart rate before, during and after the work.

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