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Assessment of temperature and humidity in domestic kitchen of Jorhat district of Assam

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Abstract
The kitchen is one of the functional working areas of the house. In the domestic kitchen indoor environmental parameters are temperature, humidity, Iiluminance and noise level. Indoor environmental parameters mainly temperature, humidity, have a profound effect on human performance, efficiency and efficacy. The present study on assessment of temperature and humidity in domestic kitchen in Jorhat district of Assam was proposed with the aim to study demographic profile and housing attributes, to measures the temperature and humidity in the kitchen during cooking and to study the relationship between dependent and independent variables. A purposive cum random sampling method was adopted. From the Jorhat Municipality area three (3) wards were selected randomly. From the wards 56 numbers of household were selected randomly. The women who involved in cooking activity were the sample for the present study. Both interview and observation method was used for collection of data which was done through a questionnaire and observation for measurement of temperature and humidity. The instruments thermo-hygrometer was used for measurement the data on temperature and humidity. Further chi square test was done to identify the relationship between dependent and independent variables. The findings showed that the average temperature was found to be 30.55 °C which is found more than acceptable limit i.e., 22.2 °C to 26.6 °C. Humidity was found to be 75.65 per cent which is also found to be higher than the acceptable value (30% to 60%). There were no relationship between temperature and humidity with selected independent variables.

Keywords: Temperature, humidity, conducive, comfort, significant level

Introduction
A kitchen, the symbol of culture of the family is the centre and the heart of the house. Kitchen is an important part of a home and is not just a place to prepare food but also can be used for recreation, family communication or even working for certain job. Cooking is a routine activity which is done from the morning till the evening; begins with preparing breakfast, lunch and dinner. Cooking is the primary activity in the kitchen which is not always considered with due weightage as a physically demanding task and has substantial physical, emotional and cognitive demands on humans (Banerjee. *et al*., 2018) [3]. Temperature and humidity are invisible indoor environmental factors that affect the quality of life and productivity of the workers (Baruah *et al.* 2014) [4]. Women are performing dual type of work both outside and inside the home and spent more energy and require a comfortable indoor environment to perform their work efficiently without any health problem (Cao *et al.* 2017, Grandjean, 1973) [6, 9]. Due to continuous performance in the kitchen, workers are exposed to high temperature and humidity which deteriorates work performance reduces work capacity and also suffers from several mental and physical discomforts (Abdullah *et al.* 2021) [1]. Indoor air temperature in residential kitchen was found to be higher than that outdoors during cooking (10.3 °C).
Temperature and humidity are factors for blockage to work performance. If the exposure toward these environmental parameters exists for a long time then these can adversely effect on the efficiency and the health of the workers. For comfort, productivity and efficiency of the women in cooking activity is depending on indoor room temperature, and humidity. The indoor environmental quality has a serious influence on the quality of life (Arif. *et al.*, 2016) [2]. Kitchen environment is highly conducive to anyone in performing daily activities especially who involved in the preparation activities. For any home makers active time starting from preparation of breakfast till lunch preparation in a day spent in the kitchen. Residential kitchen generally polluted the spaces with the use of gas stoves and such pollutants can increases the heat which is the challenges to indoor air quality and thermal comfort.

The environmental parameters such as temperature, humidity, lighting and noise are the most affecting parameters (Shobha *et al.*, 2012) [16]. They have to withstand the adverse environmental conditions such as high temperature, high humidity, improper light and too much noise inside the kitchen. Hailu *et al.* (2021) [10] found out based on the adaptive thermal comfort standard, for the month of April, the indoor thermal comfort temperature zones were expanded to (31.7 °C) and (24.7 °C). Maximum temperature of (32 °C) was recorded for the condominium house in the month of March, and a minimum temperature of (22 °C) was recorded for the traditional house. Khare, T, (2014) [13] was observed that the humidity ranged from (65-72%) and the comfortable limits of humidity are 40-50% for winter and 40-60% for summer. There are major various physiological and psychological risk factors which are associated with adverse environmental condition and becomes responsible for deteriorating the worker's working capacity (Khare, 2016) [14]. Working under excessive heat makes the homemaker tired and sleepy, reduces alertness and increases to make mistakes or accidents. Keeping this in mind the following objectives were undertaken to study demographic profile and housing attributes, to measures the temperature and humidity in the kitchen during cooking and to identify relationship between dependent and independents variables in the study area.

Methodology

A multistage purposive cum random sampling method was adopted for the study. From Jorhat municipality area 56 numbers of household were selected from 3 wards by applying Probability Proportional to Size (PPS) method. People who constructed their own home were the respondents' households for the present research study. For the present study, both interview and observation method was adopted for data collection. Data were collected personally by the researcher. Instruments thermo-hygrometer was used to record the data in the kitchen. To determine the clarity and reliability of the instrument or the interview schedule, pretesting was done. Firstly, the self- prepared questionnaire was used to obtain the personal information, demographic profile, socio economic and housing attributes of the respondents. Secondly, the environmental parameters were measured to record the temperature and humidity in the sample households. Three readings were taken from each parameter at a 15 minutes interval and finally compared to find out the relation between dependent and independent variables.

Table 1: Dependent and Independent Variables of the study

Variables	
Dependent variables	**Independent Variables**
1. Temperature	a) Location of the kitchen
	b) Number of windows in the kitchen
	c) Number of Ventilators kitchen
	d) Total area of the Kitchen
2. Humidity	a) Location of the kitchen
	b) Number of windows in the kitchen
	c) Number of Ventilators kitchen
	d) Total area of the Kitchen

Table 2: Acceptable Limit for temperature level in summer and winter seasons

Sr. No	Season	Temperature (°C)
1	Summer season	22.2 °C to 26.6 °C
2	Winter Season	20 °C to 23.3 °C

***Source*:** Mookherjee *et al.* (1953) [15], Skyes (1988) [17], CPCB, (2000) [7]

Table 3: Acceptable limit for humidity level

Sl. No	Season	Relative Humidity (%)
1	Summer season	40- 60%
2	Winter Season	40 -45%

Source: Mookherjee *et al.* (1953) [15], Illuminating Engineering Society (IES), 2019), Skyes (1988) [17]

3. Result and discussion

3.1 Demographic profile of the respondents

From the study it was observed that 44.60 per cent of the respondents were between the age group of 51- 60 years, and 37.50 percent of the respondents were belonged to the age group of 40-50 years and the minimum number of respondents i.e. 17.90 per cent was between the age group of 61-70 years. Findings of the study showed that the highest percentage (42.20%) were found to be graduate whereas 21.40 per cent were post graduate and 17.10 per cent higher secondary passed and 12.50 per cent were found to be and HSLC passed respectively. Regarding the demographic attributes of the respondents found that majority of the respondents (78.60%) were belong to the nuclear family and the minimum number of families (21.40%) were belong to the joint family. Majority of the respondents (78.60%) were having family members between 2-4 members in their household whereas 21.40 per cent were having 5-7 members in their household. Socio economic characteristics of the family found that the majority of the head of the family (98.20%) were service holder whereas 46.4 per cent of the respondents were also service holder followed by 30.40 per cent were housewife and business (23.20%). Majority of the respondent households (85.70%) had monthly income more than Rs. 50,001/-.

3.2 Housing attributes of the family

This section of the study deals with the background information of respondents in terms of facing or direction of plot, years of construction of the building, size of kitchen, numbers of ventilators in the kitchen, numbers of windows in the kitchen, types of light used in the kitchen, numbers of bulb used in the kitchen, the amount of watt of bulb used in the kitchen, position of burner/stove in the kitchen.

3.2.1 Facing/direction of plot

A perusal of Table 1 and Fig 1 on the information of the facing/direction of plot observed that 48.20 percent of the respondent's plot was facing towards North, followed by 26.80 per cent respondents plot were facing South direction and only 12.50 per cent respondents plot had facing East and West directions in the selected area.

3.2.2 Year of construction of the building

From the Table 1 it was depicted that 55.40 per cent of respondents had constructed their building before 10 years which was followed by 32.10 per cent of respondents had constructed in between 5-10 year and only 12.50 per cent of respondents had newly constructed within 5 years.

3.2.3 Size of kitchen
It was evident from the Table 1 that majority of the kitchens of the selected sample had an area less than 100 square feet (78.50%) which was followed by (21.50%) of the respondents kitchens had an area of more than 100 square feet. This may be due to the fact that time is very much scare for housewife and not able to maintain a large kitchen.

Kitchen is a place where family members are performed cooking, worship and bonding together and even socializing with friends and family. In some of families of study area the size of the kitchen was more. They used the kitchen space not only for cooking but also used for worship and as well as dinning purpose.

3.2.4 Location of the kitchen
It was observed from the Table 1and Fig. 2 that 32.10 per cent respondents were North facing Kitchen, which was followed by 26 per cent kitchen were East facing direction, 21.40 per cent were West facing direction and 19.60 per cent kitchen were South facing direction.

3.2.5 Number of windows in the kitchen
It was observed from the Table 1, that majority of the respondent's (95%) had only one window which was followed by 5 per cent of the respondents had 2 windows in the kitchen.

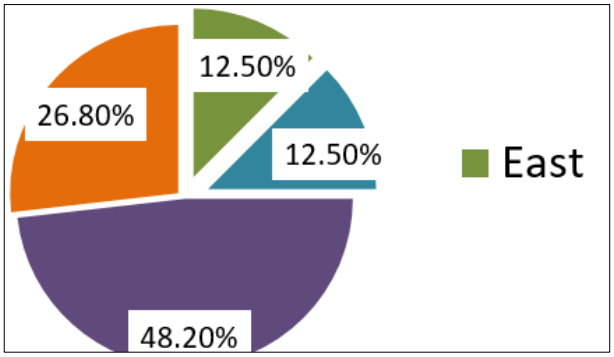

Fig 1: Distribution of respondents according

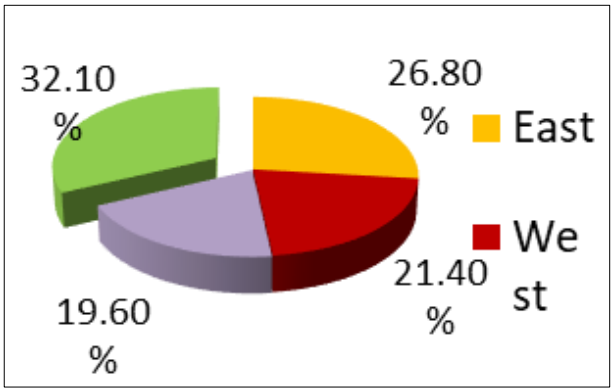

Fig 2: Distribution of respondents to direction of plot according to location of kitchen

3.2.6 Number of ventilators in the kitchen
It is quite clear from the Table 1, that 95 per cent of the respondents had 1 ventilator in the kitchen, followed by 5 per cent of the respondents were having 2 ventilators in the kitchen.

3.2.7 Types of light
The data highlights in Table 1, depicted that the most commonly used source of light during day time was day light or natural light (67.9%) followed by 32.10 per cent of the respondents was used CFL as a source of light while cooking.

3.2.8 Number of bulb used in the kitchen
It was clear from the Table 1 that cent percent (100%) of the respondents were using only one bulb in the kitchen.

Table 4: Distribution of the respondents according to their housing attributes. N = 56

Sr. no	Attributes	Frequency	Percentage
	A. **Facing/ Direction of Plot**		
1	East	7	12.5
2	West	7	12.5
3	North	27	48.2
4	South	15	26.8
	Total	56	100.0
	B. **Year of construction of the building**		
1	5 year	7	12.5
2	5 - 10year	18	32.1
3	Above 10 year	31	55.4
	Total	56	100
	C. **Size of Kitchen**		
1	Less than 100 sq. ft	44	78.50
2	More than 100 sq. ft	12	21.5
	Total	56	100.0
	D. **Location of the kitchen**		
1	East	15	26.8
2	West	12	21.4
3	South	11	19.6
4	North	8	32.1
	Total	56	100
	E. **Numbers of windows in the kitchen**		
1	1	53	94.6
2	2	3	5.4
	Total	56	100.0
	F. **Numbers of Ventilators in the kitchen**		
1	1	53	94.6
2	2	3	5.4
	Total	56	100.0
	G. **Types of light used in the Kitchen**		
1	Day light	38	67.9
2	CFL	18	32.1
	Total	56	100.0
	H. **Numbers of bulb used in the Kitchen n = 18**		
1	1 bulb	56	100.0
2	2 bulb	-	-
	Total	56	100.0
	I. **The amount of watt of bulb used in the kitchen**		
1	Up to 20 watt	56	100.0
2	More than 20 watt	-	-
	Total	56	100
	J. **Position of Burner/Stove in the kitchen**		
1	East side	16	28.6
2	West side	12	21.4
3	South side	14	25
4	North side	14	25
	Total	56	100.0

3.2.9 The amount of watt of bulb used in the kitchen
It is evident from the Table 1 that 100 per cent of the respondents were using bulb that is up to 20 watt of bulb in the selected area of the house.

3.2.10 Position of burner/stove in the Kitchen

The data given in Table 1 on the information of the position of stove in the kitchen and observed that 28.60 per cent of the respondent's kitchen burner/stove was in East side, followed by 25 per cent respondents kitchen stove were in South and North side and only 21.40 per cent respondents kitchen stove was in West side of the kitchen in their house.

3.3 Measurement of temperature and humidity in the kitchen during cooking

This section of the study emphasizes at outlining the measurement of environmental parameters in terms of temperature and humidity which were measured in a selected area. The data on environmental parameters were collected from the sample area in the month of October.

3.3.1 Measurement of temperature in the kitchen during cooking

Temperature is the measure of warmth or coldness in reference to a set standard, often expressed in terms of degrees Fahrenheit or Celsius. It is measured by the instrument Thermo-Hygrometer**.** The Temperature was recorded in the month of October from the study area.

The recorded temperature ranges are presented in Table - 2. The three readings were taken after 15 minutes to find out the minimum and maximum temperature in the selected area. The minimum ranges of temperature were 26.6 °C and the maximum ranges of temperature were 34.5 °C respectively. It was depicted that the average range of temperature were 30.55 °C in the selected area of the domestic kitchen which was found to be more than acceptable limit. The Fig 3 indicates the minimum and maximum values of temperature in domestic kitchen.

Table 5: Distribution of Temperature range in domestic kitchen during cooking N=56

	Minimum (°C)	Maximum (°C)	Average (°C)	Acceptable Limit
Temperature	26.6 °C	34.5 °C	30.55 °C	22.2 °C to 26.6 °C (Summer) 20 °C to 23.3 °C (Winter)

As compared to the acceptable limit given by Illuminating Engineering Society (IES), 2019) Fig: 4 showed that an average value (30.55%) of temperature which was conducted on the month of October is higher than the acceptable limit i.e., 22.2 °C to 26.6 °C.

According to the study conducted by Deb (2018) on assessment of noise, temperature, light intensity and their impacts on workers in footwear and leather products industries of Bangladesh revealed that 36.4 °C was found to be maximum temperature in lasting department and 31.5 °C was found to be maximum temperature in cutting department.

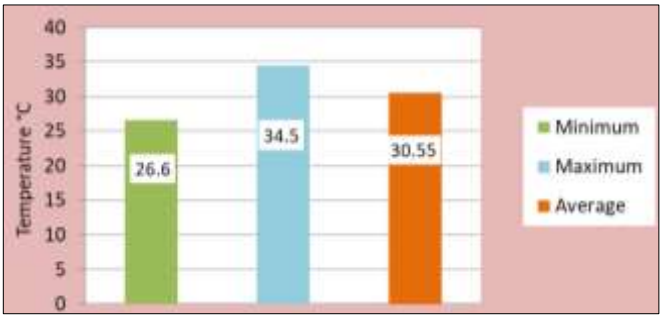

Fig 3: Distribution of the maximum and minimum value of temperature

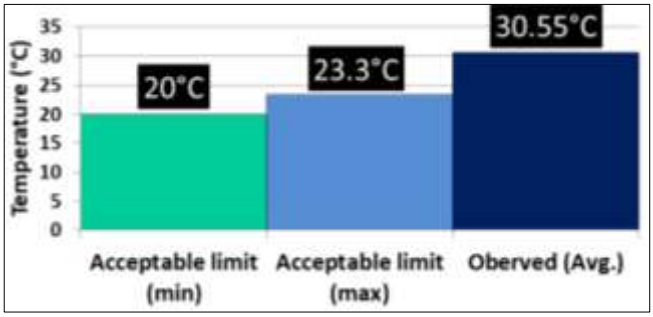

Fig 4: Distribution of Observed (Avg.) and Acceptable Limit of temperature

Measurement of humidity in the domestic kitchen during cooking

Humidity refers to the amount of water vapor, or moisture, in the air. Humidity is usually explained as relative humidity. Relative humidity is the amount of water vapour actually in the air, expressed as a percentage of the maximum amount of water vapour the air can hold at the same temperature. It is measured by the instrument Thermo-Hygrometer. The humidity was recorded in the month of October from the study area.

Data presented in Table 3, showed that out of the total selected area the minimum humidity range were 64.30 per cent and it can also be seen that maximum humidity range was 87 per cent. It was thus found that the average range of humidity was found 75.65 per cent in the selected kitchen. The Fig. 5 showed the minimum and maximum values of relative humidity.

Table 3: Distribution of Humidity range in domestic kitchen during cooking

	Minimum	Maximum	Average	Acceptable Limit
Humidity	64.3%	87%	75.65%	40 to 45% (Winter Season) 40 to 60% (Summer season)

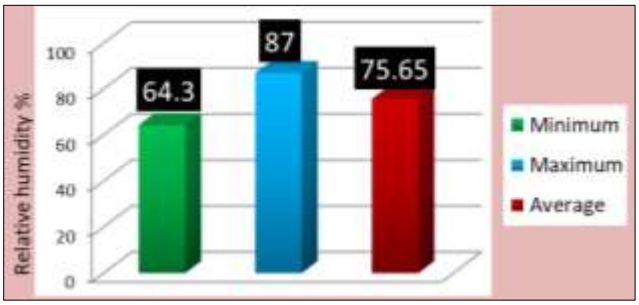

Fig: 5: Distribution of maximum and minimum value of humidity

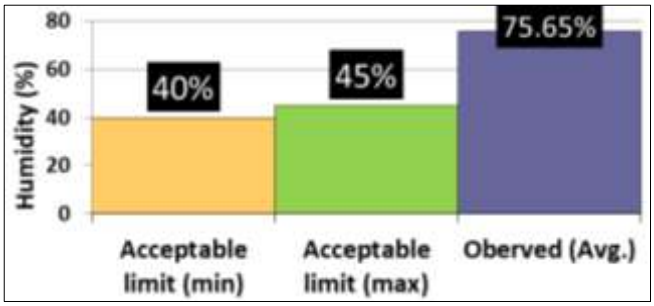

Fig 6: Distribution of Observed (Avg.) and Acceptable Limit of Humidity

Further regarding the acceptable limit, the collected data emphasizes that the average value of humidity (75.65%) which was also conducted on the month of October is also higher than the acceptable value (40% to 45%) given by Skyes (1988) [17] presented in Fig 6.

Bhatt, (2012) who conducted a study on ergonomic assessment of work station for females engaged in cooking activities outline that the majority of the humidity level was 48-52 per cent in the kitchen area.

3.4 Distribution of respondents according to practices followed for temperature and humidity in the kitchen.

A good practice to reduce temperature and humidity is essential for the wellbeing and efficient working of the workers and its environment should be comfortable for performing daily kitchen activities.

Further regarding the practices followed to reduce temperature and humidity (Fig - 7), it was observed that 21.40 per cent of respondents were practices by use of window covers like blinder and curtain during working hours, which was followed by 17.80 per cent of respondents were practicing by wear comfortable clothes, 14.20 per cent were following practices by use of table or ceiling fan, 12.5 per cent of respondents practices by use of less iIluminance. Whereas 5.30 per cent were use microwave and 3.50 per cent were use induction stove to reduce temperature and humidity. This is indicated of the fact that almost 70 per cent of the respondents were not aware of such practices.

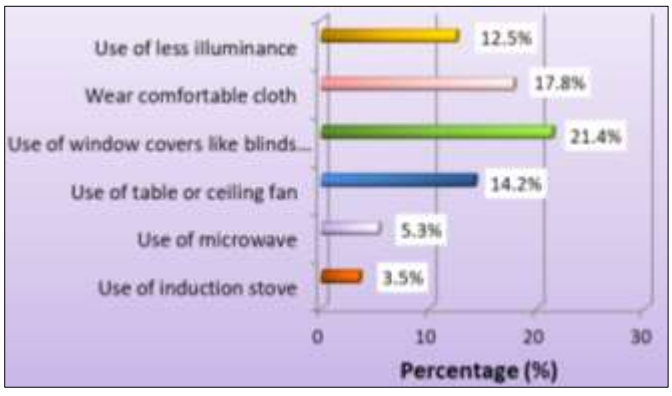

Fig 7: Distribution of practices followed to reduce temperature and humidity

3.5 Identification of the relationship between the selected independent variables and dependent variables.

These studies of the relationship between the selected independent variables and dependent variables were computed using chi square test. The dependent variables were temperature, humidity, whereas independent variables selected were, location of the kitchen, numbers of windows and numbers of ventilators, area of the kitchen,.

Based on the relationship between temperatures with selected independent variables it was observed from (Table 4) that there was no relationship between temperature and numbers of windows and numbers of ventilators ('p'=0.392) and area of the kitchen ('p'=0.039***).** However data showed that there was no significant association between temperature and location of the kitchen ('p'=0.209).

Table 4: Identification of the relationship between the selected independent variables and dependent variables.

Dependent variable	Independent variable	x^2 value	p value
Temperature	a) Location of the kitchen	135.409	0.209
	b) Number of windows in the kitchen	42.851	0.392
	c) Number of ventilators in the kitchen	42.851	0.392
	d) Area of the kitchen	42.141	0.421
Humidity	a) Location of the kitchen	106.310	0.222
	b) Number of windows in the kitchen	36.277	0.276
	c) Number of ventilators in the kitchen	36.277	0.276
	d) Area of the kitchen	109.869	0.158

(**)= Significance level 5%

Regarding the relationship between humidity with type of kitchen, number of windows and number of ventilators, location of the kitchen and area of the kitchen shown in the (Table 4). Hence it stated that no significant relationship was found between selected independent variables. Nevertheless, the data also showed that there was no relation between humidity with location of the kitchen and area of the kitchen ('p'=0.222, 'p'=0.158) respectively. Therefore, the null hypothesis is accepted.

Conclusion

From the study it can be concluded that application of ergonomic principles for proper workplace design will be successful if the environmental parameters mainly temperature and humidity are congenial for the worker or users. Temperature, and humidity are invisible indoor environmental factors that affect the quality of life and productivity and most of the respondents were not concerned about the complications related to these. Temperature is a very critical pollution for the workplaces because higher temperature is hazardous and hampers the regular activities and productivity. This study revealed that the existing average temperature (30.55 °C) in the selected area far exceeds the standard limit. It was also found that the average humidity in the kitchens under study was (75.65%) which was higher than the acceptable limit (40% to 60%). The environmental parameters of the kitchens under the study area were not conducive to the users.

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