AN ASSOCIATION BETWEEN MICROSCOPIC HOUSE DUST MITES AND DWELLINGS: A STUDY AMONG URBAN HOMES OF UDAIPUR DISTRICT

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ABSTRACT

There are many substances in household dust which can cause allergies in humans, including animal dander, insect parts (especially from cockroaches) and pollen. The most common allergenic components of house dust, however, are from house dust mites. House dust mites are tiny creatures related to ticks, chiggers, and spiders that live in close association with humans. Their primary food is dander (skin scales) shed from human and pet activity. Most homes in India probably have detectable levels of house dust mites and their allergy-producing fragments. India has one of the most degraded environments in the world and it is paying heavy health and economic price for it. In India, the rapid increase of human numbers combines with desperate poverty to deplete and pollute local resource base on which the livelihood of present and future generations depends. In this study an attempt was made to assess the causative housing factors for the growth of HDMs (House Dust Mites) also concentration of these in different areas of the house and its control measures were also examined in the study. Household-cleaning pattern adopted by the respondents, and their awareness regarding (House Dust Mites)were evaluated in their houses. An association was found among factors associated with house dwellings and occurrence of House Dust Mites.

Keywords: House Dust Mites, Allergy, Zones, Low, Moderate, High, Non Conventional Plant Products.

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Introduction

House dust mites are not parasitic nor are they capable of biting or stinging humans. Their significance as pests is due to the powerful allergens contained in the mites, their cast skins, fecal material and secretions. Symptom of a house dust mite allergies include stuffy or runny nose, sneezing, coughing or watery eyes. Inhalations of dust mite allergens by hypersensitive individuals can result in acute attacks of bronchial asthma, accompanied by wheezing, shortness of breath, and perhaps even death. Diagnostic tests and clinical studies by allergists have shown house dust mite to be the most common allergy in asthmatics, and an important "cause" for the development of asthma in young children. Recent studies suggest that at least 45 percent of young people with asthma are allergic to house dust mites. Unlike "seasonal" allergies caused by molds and pollen, people who are allergic to dust mites often will have symptoms year round.

Mite Description and Detection

House dust mites are tiny adults are about 0.5 mm long and the immature are even smaller. Consequently, they generally are visible only with the aid of a microscope. The mites are globular in shape, clear to creamy white in color, with hairs on their legs and body. There are two common species of house dust mites are **Dermatophagoides farinae**, and the European house dust mite, **D. pteronyssinus**.

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The presence of house dust mites can be confirmed by collecting dust samples from inside the home and examining them under a microscope. Another diagnostic test more accessible to householders can be purchased from drug and allergy supply stores. The detection kits (e.g., Acarex) measure the presence and infestation level by combining dust samples, collected from various places inside the home, with indicator reagents. Sensitivity to house dust mites and their allergenic proteins can be confirmed by an allergist-immunologist, via a skin and/or blood test.

Respondents' Housing Information

Housing is one of the basic necessities of man. The quality of housing conditions is directly linked with the health status of family. The study was delimited to access the impact of housing conditions on the growth of House Dust Mites by gathering information such as orientation of house, type of house, age of house construction, building material used, situation of the house, years of house occupancy and size of the dwelling, ventilation etc. It reflects the zonal difference in the housing conditions of the respondents which affect House Dust Mites growth. Much of the information related to housing was obtained through qualitative technique i.e. participant observation.

Materials and Methods

Exploratory cum experimental research design was used for the study. The present empirical research aims to study the House Dust Mites management from indoor environment through Non Conventional Plant Product Component. A causal comparative analysis was done to find out the factors responsible for the growth of House Dust Mites . Investigation was also made to find the effect of human activities of different zones on households.

The unit of enquiry was urban households from three different zones viz. Residential zone, Commertial zone and Industrial zone of Udaipur and key informants were homemakers. Through participatory observation, investigator personally collected information regarding respondents' housing conditions as ventilation, dampness and cracks in the house, orientation of house, number of storeys of house etc. which leads to occurrence of House Dust Mites affecting the health status of the household members. Settled dust samples from furnishings, furniture, flooring, drawers and cabinets from four different rooms i.e. living, dining, bed room and kitchen were collected for measuring House Dust Mites. The reasons for selecting these different rooms purposively were as under:

- **Living Room:** Living room is the place where family members spend most of time with each other in entertaining guest or watching television and talking with each other in this room. Thus, foot traffic of guests and family members bring dust inside the room which settles on the furnishings and furniture of the room.

- **Dining Room**: It is the place where family members assemble daily for breakfast, lunch and dinner. Apart from family members, guests also amass on special occasions in dining room. Family members eat food in this room and communicate with each other. While taking food, the small food particles fall on the floor which accumulates House Dust Mites in the room.

- **Bed Room:** One third of the person's lifeis spent at rest and sleep therefore bedroom is the most important room in the house.The variety of pollutants resulting from various human activities is a constant source of deterioration in the air quality. Draperies, rugs and fabric, most of which are synthetic, are source of a variety of organic and microbial contaminants. Bed mattress on which, human being rest increases the moisture content that creates suitable conditions for the growth of House Dust Mites. Carpet on the floor is a good source of suspended particulate matter and dust mites. If regular cleaning is not done it adds the House Dust Mites in indoor environment.

- **Kitchen:** Kitchenis the place for food preparation and to serve meals to family members.Homemakers spent majority of the time in kitchen in preparation and cooking food. Cleanliness of kitchen is necessary otherwise it becomes breeding place for pests, insects and micro organisms. Cooking generates heat and smoke, which increases the temperature and humidity in the kitchen hence, increases the chances for microbial growth.

Environmental Parameters

To judge the indoor environmental status 4 in 1 environmental tester (B.W. technical, Canada) was used to measure the micro climatic parameters of the rooms which are helpful in promoting growth of House Dust Mites. These parameters are as follows:

Measurement of Parameters by 4 in 1 Environmental Tester

A change in moisture content will alter the physical and chemical characteristics of air. The absorption of moisture is dependent on the temperature and partial pressure of the atmosphere, and hence on its humidity. The indoor air flow rate significantly affects the level of pollution inside the building. Good ventilation can considerably improve the quality of air in the building. Intensity of light varies according to time period. More openings in home may affect the intensity of natural light. These microclimatic factors affect the House Dust Mites concentration in indoors. Non conventional plant product component (NCPPC) was sprayed in living, dining, bedroom and kitchen area furnishings, furniture, flooring, drawers and cabinets of the respondents' houses. The dust samples were collected in the polythene bags, sealed and carried to the laboratory within 12 hours. In the lab the dust samples were sieved and 2 gm of dust from each area was observed under binocular microscope (10 x) and House Dust Mites mortality rate was recorded. House Dust Mites which were non mobile, at least for five minutes were considered as motile. Data quantified from the survey was statistically analyzed by employing descriptive as well as relational statistics for drawing inferences.

Results and Discussion

The various causative housing factors are responsible for the growth of House Dust Mites, Among them some of the factors that were taken for the research are as follows:

- **Orientation of the House**

Placing of different units of building with respect to the sun, prevailing wind direction, rain and topography of the locality is called as orientation. The house orientation determines the natural amount of solar radiation. The access or lack of these factors through different directions may leads to the growth of microorganisms in home.

In Table 1, predominance of west oriented houses (35.00 per cent) was found, followed by north (32.50 per cent), east (20.00 per cent) and south (12.50 per cent) respectively. Inter zonal comparison revealed that higher number of the respondents' house orientation was towards east (40.00 per cent) in RZ, west (50.00 per cent) in Commercial zone and north (45.00 per cent) in Industrial zone. Intra zonal variation revealed that cent per cent of the residential zone respondents' houses fall in higher House Dust Mites category had east oriented houses which will have morning sunlight. Near about two third of the respondents' houses from commercial zone and Industrial zone were west oriented which falls in higher House Dust Mites category.

- **Condition of the House**

Condition of the house is an important determinant of indoor House Dust Mites (Ginger et al. 1998). Tabulated data clearly highlights that majority (93.33 per cent) of the respondents' houses were *pacca*. A meager percentage (6.66 per cent) of the respondents had *katcha – pacca* houses. None of the respondent was having *katcha* house. It was explicit from the data that cent per cent of the respondents had *pacca* houses in Industrial zone because most of them were living in industrial houses. Along with suitable environmental conditions, old and new house (*pucca*) buildings had greater risk of the House Dust Mites accumulation in home environment. The nooks and corners in the *pacca* walls are the hub of House Dust Mites.

- **Type of Houses**

Type of house is an important factor in limiting mite population. Half of the respondents had detach houses where as one third of the respondents had attached houses (36.00 per cent). Impact of urbanized culture was seen among few of the respondents residing in apartments (13.00 per cent). Perusal of zonal data distribution showed in Fig: 1 that majority of the respondents had attached (80.00 per cent) houses in commercial zone. This is because houses in these areas were very old and made without proper planning. Dominance of detach houses was found in residential zone (70.00 per cent) and Industrial zone (60.00 per cent). Zonal variation depicts lower number (10.00 per cent) of attached houses in residential zone. Only one fifth of the respondents were having attached houses in commercial zone and apartments in residential zone. Cent per cent of residential zone respondents falling in higher House Dust Mites category had detach houses.
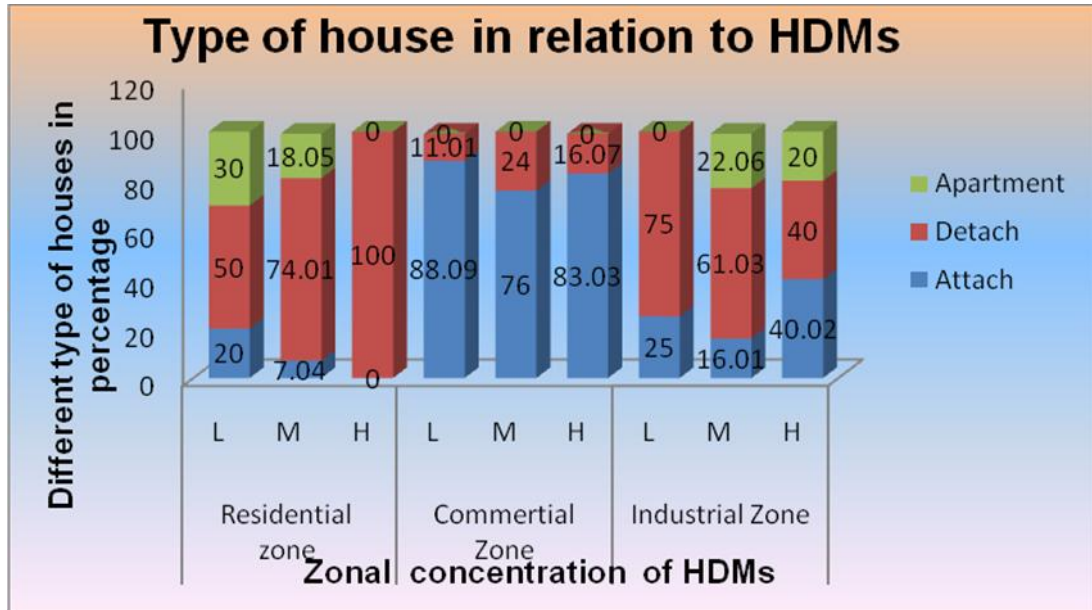
L= Low, M= Moderate, H=High

Figure: 1 Type of house in relation to House Dust Mites(HDMs)

- **Number of Storeys**

The concentration of House Dust Mites is influenced by physical factors such as structure and material of house, number of storey in the house etc.. Tabulated data depicts that more than half (53.33 per cent) of the respondents' houses were on ground floor. Near about one third of the respondents were living on first storey and rest of them (16.66 per cent) lived on the second storey of the house. This is because at ground level dust can be easily carried indoors through feet and air flow and settles in furniture, furnishings, floor etc. Wickman et al. (1994) also support these findings that higher number of House Dust Mites were found from beds located on the ground floor as compared to mattress dust from upper floor.

- **Situation of the House**

Accumulation of dust is the most significant factor for the growth of House Dust Mites. It depends upon the house situation. The data in Table 1 reveals that near about half of the respondents (46.67 per cent) houses were situated inside streets whereas 40.00 per cent houses were on the road. Only a meager percentage (13.33 per cent) of the respondents' houses were situated on the corner of the road. Thirty per cent of the respondents in commercial zone and 40.00 per cent in residential zone respondents' houses were situated on the main road. These houses have more chances of dust accumulation through road traffic and outer pollution which creates favorable conditions for House Dust Mites concentration. In residential zone cent per cent of the higher House Dust Mites category respondents' houses were situated inside the street. However, in commercial zone 66.70 per cent of the higher House Dust Mites category respondents' houses were situated on the main road.

Table 1: Mean and percentage distribution of respondents according to their housing information

S, No.	Housing information	RZ				CZ				IZ				Overall N=120
		L n=10	M n=27	H n=3	Total N=40	L n=9	M n=25	H n=6	Total N=40	L n=4	M n=31	H n=5	Total N=40	
1	Orientation of the house													
	North	30.00	22.20	0	22.50	44.40	28.00	16.70	30.00	25.00	48.40	40.00	45.00	32.50

	South	0	11.10	0	7.50	11.10	12.00	0	10.00	25.00	22.60	0	20.40	12.50
	East	50.00	29.60	100.0	40.00	0	12.00	16.70	10.00	25.00	9.70	0	10.00	20.00
	West	20.00	37.00	0	30.00	44.40	48.00	66.70	50.00	25.00	19.40	60.00	25.00	35.00
2	**Condition of the house**													
	Katcha-pucca	10.00	11.10	0	10.00	11.10	8.00	16.70	10.00	0	0	0	0	6.66
	Pucca	90.00	88.90	100.00	90.00	88.90	92.00	83.30	90.00	100.0	100.0	100.0	100.0	93.33
3	**Type of house**													
	Attach	20.00	7.40	0	10.00	88.90	76.00	83.30	80.00	25.00	16.10	40.20	20.00	36.66
	Detach	50.00	74.00	100	70.00	11.10	24.00	16.70	20.00	75.00	61.30	40.00	60.00	50.00
	Apartment	30.00	18.50	0	20.00	0	0	0	0	0	22.60	20.00	20.00	13.33
4	**Number of storey**													
	Ground floor	40.00	33.30	100.0	40.00	33.30	32.00	16.70	36.00	75.00	93.50	80.00	90.00	53.33
	First floor	60.00	66.70	0	60.00	44.40	32.00	0	30.00	0	0	0	0	30.00
	Second floor	0	0	0	0	22.20	36.60	83.30	40.00	25.00	6.50	20.00	10.00	16.66
5.	**Age of the house (in years)**													
	Mean	27.80	22.81	34.33	24.92	43.00	44.96	38.00	43.47	39.00	39.06	39.20	39.70	35.82
	SD	13.45	11.00	10.50	11.83	18.29	17.88	23.73	18.70	13.34	14.20	27.18	15.64	17.21

6.	Period of house occupancy (in years)													
	Mean	20.00	14.09	19.00	15.30	32.22	28.44	34.50	30.20	10.00	11.52	6.33	9.75	18.75
	SD	19.06	11.17	18.02	12.89	4.40	9.09	15.10	9.46	5.55	5.79	0.56	5.62	12.79
7	Situation of house													
	On corner of the road	20.00	22.20	0	8.00	0	0	0	0	25.00	22.30	0	20.00	13.33
	On the main road	50.00	40.70	0	40.00	33.30	52.00	66.70	50.00	25.00	25.80	60.00	30.00	40.00
	Inside the street	30.00	37.00	100.00	40.00	66.70	48.00	33.30	50.00	50.00	51.60	40.00	50.00	46.67
8	Number of rooms in the house													
	Three	20.00	7.40	0	10.00	0	12.00	16.70	10.00	25.00	25.56	40.00	40.00	19.66
	Four	40.00	59.30	0	50.00	88.90	64.00	66.70	70.00	50.00	35.50	60.00	40.00	53.33
	More	40.00	33.30	100.0	40.00	11.10	24.00	16.70	20.00	25.00	22.60	0	20.00	26.66
9.	Door and window area of houses (sq. feet)													
	Mean	373.90	378.70	353.00	375.57	357.75	376.45	332.00	369.02	396.77	370.56	385.00	378.62	374.40
	SD	38.90	43.04	0	40.38	25.11	48.56	26.65	46.56	38.55	42.99	49.87	43.42	43.35

which causes greater indoor dust accumulation and with suitable environment conditions it leads to House Dust Mites growth. People living on the main road were too much exposed to outdoor dust and related problems. On the main road commercial activities and vehicular transportation were the main cause of indoor pollution. Furthermore, in commercial zone 66.70 per cent of the lower House Dust Mites category respondents' houses were situated inside the street which had less pollution.

- **Number of Rooms**

Size of house and number of rooms within the house affect the time and energy utilization of homemaker in household cleaning. Inadequate space in house affects health as well as the quality of life . Apart from kitchen and other storage and service areas number of rooms in the respondents' house includes living, dining and bed room. Most of the respondents' houses were of four (53.33 per cent) rooms. Some of the respondents had three (19.66 per cent) rooms. Near about one fourth (26.66 per cent) of the respondents had more than four rooms in the house. Intra zonal variation revealed that cent

per cent of the residential zone respondents living in more than four rooms house had higher concentration of House Dust Mites. Increased space in the house needs proper cleaning from hygienic point of view. Improper cleaning accumulates dust in the house and causes problem of House Dust Mites. Sixty per cent of the respondents in Industrial zone had four rooms in their houses and showed higher concentration of House Dust Mites.

- **Age of the Houses**

Age of the house is an important factor which influences House Dust Mites growth and proliferation. The average age of the respondents' houses was found to be 35.82 years (SD=17.21). Inter zonal variation revealed higher than the average age of respondents' houses in commercial zone (43.47 years) as compared to Industrial zone (39.07 years) and residential zone (24.92 years). High House Dust Mites category respondents' were having higher average age of their houses in residential zone (34.33 years) and Industrial zone (39.20 years). Higher concentration of mites in older houses was due to greater chances of settled dust and food material accumulation. In the commercial zone where the oldest houses were found, House Dust Mites concentration was high. This was also an outcome of commercial activities, vehicular and pedestrian pollution. Several studies also reported similar findings. The older the house, more the multiplication of mite population than the newly built houses.

- **Period of House Occupancy**

Time period of respondents' occupancy (in years) in that particular house at the time of investigation was recorded for the present investigation. Respondents' average occupancy in the houses(Figure:2) was 18.75 years (SD= 12.79). Figure 1 highlighted that respondents' average house occupancy period was more in commercial zone (30.20 years, SD=9.46 years) than other zones residential zone (15.30 years) and Industrial zone (9.75 years). In commercial zone average house occupancy period was higher (34.50 years) among high House Dust Mites category respondents.

- **Dampness and cracks in the house**

Dampness and cracks in the house affects the health and comfort of the occupants. Dampness in the house is one of the favorable factors for the growth of House Dust Mites among households in a study found clear association between asthma and house dampness, mould exposure and House Dust Mites because they are found most often in damp places.

Table 2: Percentage Distribution of Respondents According to Dampness and Cracks in their Houses

S. No.	Particulars	RZ				CZ				IZ				Overall N=120
		L n=10	M n=27	H n=3	Total N=40	L n=9	M n=25	H n=6	Total N=40	L n=4	M n=31	H n=5	Total N=40	
1.	Dampness in the house*													
a	Living	10.00	14.00	33.30	15.00	22.20	28.00	33.30	27.50	75.00	12.90	20.00	12.50	18.33
b	Dining	20.00	14.80	100.0	15.00	22.20	12.00	33.30	50.00	25.00	45.20	40.00	42.50	46.66
c	Bedroom	10.00	25.90	33.30	22.50	44.40	20.60	33.30	27.50	75.00	9.70	0	15.00	21.66
d	Kitchen	30.00	14.80	0	17.50	11.10	18.00	0	7.50	25.00	32.30	20.00	30.00	18.33
e	Bathroom	30.00	29.60	33.30	30.00	0	32.00	16.70	22.50	0	25.80	60.00	27.50	26.66
2.	Cracks in the house*													
a	Living	0	14.80	33.30	12.50	11.10	12.00	50.00	10.00	25.00	29.00	20.00	27.50	16.66
b	Dining	40.00	37.00	0	35.00	11.10	28.00	33.30	25.00	50.00	29.00	40.00	27.50	29.16
c	Bedroom	20.00	14.80	0	15.00	33.30	12.00	16.70	17.50	25.00	12.90	20.00	12.50	15.00
d	Kitchen	20.70	14.80	33.30	17.50	22.20	16.00	16.70	17.50	50.00	0	0	2.00	16.00
e	Bathroom	20.0	18.5	33.3	20.0	22.2	32.0	33.3	30.0	0	29.0	40.0	27.5	25.83
3.	Water leakage													
a	Leakage	50.00	44.40	100.00	50.00	11.10	32.00	50.00	30.00	50.00	41.90	20.00	40.00	40.00
b	No leakage	50.00	55.60	0.00	50.00	88.90	68.00	50.00	70.00	50.00	58.10	80.00	60.00	60.00
4.	Ventilation													
a	Proper	60.00	55.60	0	52.50	11.10	60.00	66.70	50.00	75.00	54.80	60.00	57.50	53.33
b	Improper	40.00	44.40	100.0	47.50	88.90	40.00	33.30	50.00	25.00	45.20	40.00	42.50	46.66

*Multiple Responses

- **Dampness:** Concentration of House Dust Mites is influenced by the condition of house like dampness or cracks in the house. Dampness in the building create unhealthy living conditions, at the same time breaks and cracks in walls and roofs may serve as breeding ground for various type of microorganisms. Figure 3 shows that excessive dampness in house was observed in the bathrooms (26.66 per cent) followed by bedroom (21.66 per cent), living room (18.33 per cent) and kitchen (18.33 per cent). Inter zonal comparison revealed that higher percentage of the respondents (27.50 per cent) had dampness in living room in commercial zone. Respondents had dampness in kitchen (IZ=30.00 per cent) and bathrooms (RZ=30.00 per cent). Intra zonal variation revealed that one third of the respondents of high House Dust Mites

category had dampness in living room, bedroom and bathrooms. Higher number of respondents that falls in the lower House Dust Mites category in commercial zone (44.40 per cent) and Industrial zone (75.00 per cent) had dampness in their bedrooms.
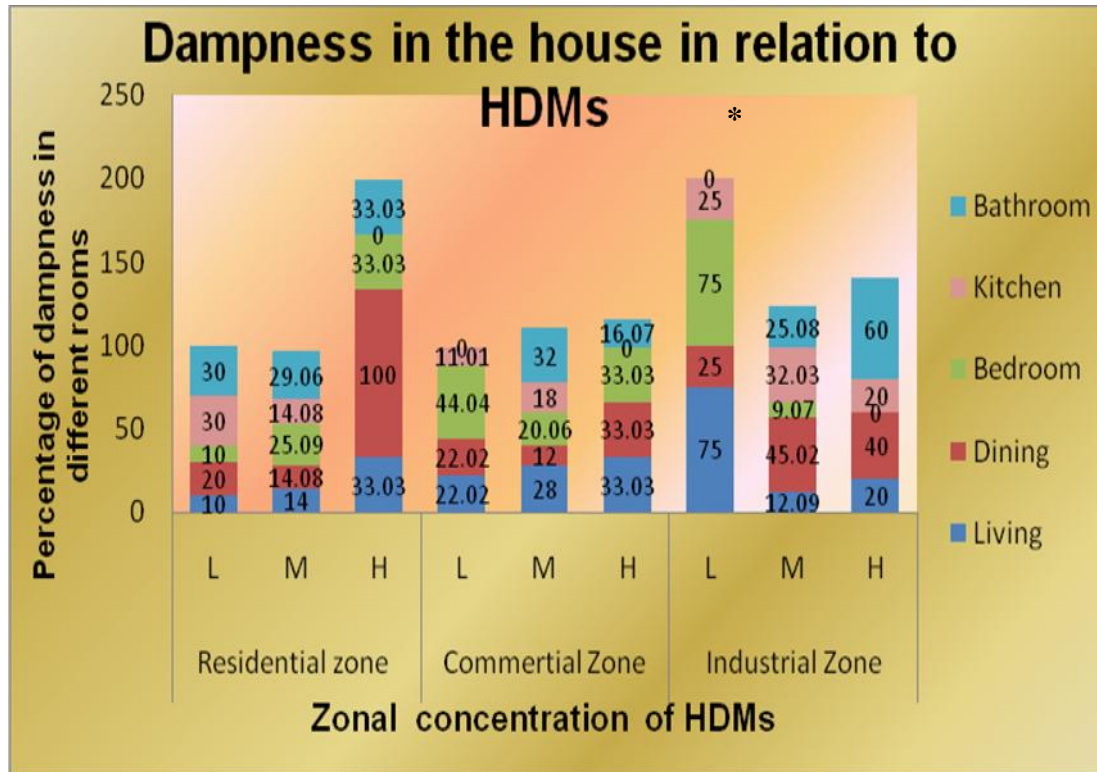
L= Low, M= Moderate, H=High

* Multiple responses

Figure 3: Dampness in the house in relation to House Dust Mites(HDMs)

- **Cracks:** House Dust Mites are also found in cracks of the floor and other protected places. Cracks were found in respondents' dining room (29.16 per cent) and bathrooms (25.83 per cent). More than one third of respondents (35.00 per cent) in residential zone had cracks in their dining room. In commercial zone near about one third of the respondents (30.00 per cent) had cracks in their bathrooms. More than one fourth of the Industrial zone respondents had cracks in their living, dining and bathrooms (27.50 per cent each). In residential zone 40.00 per cent of the respondents faced cracks problem in their house fall in lower House Dust Mites category. Respondents of lower and high House Dust Mites category had cracks in dining and bedroom in commercial zone.

House Dust Mites hide in the dust of the cracks because these places are dark and damp. also upholds similar results that House Dust Mites are found in the cracks of the floor and other protected places. Cracks in room over an unheated area are attractive for the dust mites because the air in these cracks is relatively moist.

- **Water Leakage Problem**

Leakage of water from roof and walls is also one of the friendly locations for the growth of House Dust Mites because it increases the percentage RH of indoor environment. Water leakage problem through rain was common in 40.00 per cent respondents' houses (Table: 2) .Half of the respondents in residential zone face water leakage problem in their houses. Cent per cent of the residential zone and half of the commercial zone respondents in commercial zone of high House Dust Mites category face water leakage problem in their houses. Water leakage in the homes increase indoor RH which directly favors intensification of House Dust Mites.

- **Ventilation**

Ventilation means supply of fresh air and removing dust, heat and other pollutants from indoors for human comfort. Proper ventilation is an important step in household cleaning because a well ventilated house can more easily provide dry conditions that are inimical to House Dust Mites. Improper ventilation and faulty cleaning practices are the main reasons for the occurrence of House Dust Mites. Better cleaning practices and proper waste disposal are necessary steps for the control of House Dust Mites.

Table:2 depict that Near about half (53.33 per cent) of the respondents had proper ventilation in their house where as rest (46.66 per cent) of respondents houses were improperly ventilated. More than the half (57.50 per cent) of Industrial zone respondents houses were ventilated. Half of the respondents' houses in commercial zone were improperly ventilated. Commercial zone is situated in centre of the city which had densely built up areas. In this zone attached houses were more thus air circulation was improper which creates indoor pollution and dust accumulation in the house. In residential zone cent per cent of the respondents belonged to high House Dust Mites category had improperly ventilated houses. It was striking to note that in commercial zone majority (88.90 per cent) of the respondents' belonged to lower House Dust Mites category had improper ventilated houses. Improperly ventilated houses enhanced the exposure of moulds and House Dust Mites that can cause an increased risk on allergic sensation.

Conclusion

House Dust Mites are minute micro organisms which are invisible whereas pests are visible from naked eyes gave them greater awareness. The settled dust should be cleaned regularly from indoors otherwise it will settle in lungs with breathing. Various factors ie. number of rooms, period of house occupancy, area of doors and windows, number of storeys, orientation and condition of houses etc. were studied in houses. Most of the respondents in residential zone found high concentration of microscopic house dust mites. Improper ventilation, dampness and cracks and water leakage problems were the main reasons for the accumulation of House Dust Mites.

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