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Housing Conditions Affecting Concentration of House Dust Mites (HDMs) and its Effect on Homemakers Health

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ABSTRACT Housing conditions are directly linked with health status of the respondents. Improper cleaning of house leads to insanitary and unhygienic conditions leading to dust accumulations which are the major cause of HDMs. These HDMs hides in indoor settled dust and creates various allergic diseases in human beings. Hence, the present paper aims to study the housing condition responsible for HDMs concentration and to assess the health of respondents' in relation to severity of HDMs complications. Significant association was found between HDMs concentration and number of storeys, period of house occupancy, dampness, ventilation and presence of pets in the house. The common HDMs complications faced by the women were asthma, skin rashes, wheezing, coughing, fatigue, headache etc. One- fifth of the respondents' faced these complications as severe. Therefore, awareness regarding HDMs complications and housing conditions should be imparted to the homemakers which will reduce their health problems.

INTRODUCTION

Housing is one of the basic necessities of man. The quality of housing conditions is directly linked with the health status of the family (Lou et al. 1990; Hart 1998). Housing condition is a major cause in the prevalence of HDMs in homes. Presence of dust and its assemblage micro organisms in the house depends on orientation, type, age and situation of the house. Improper cleaning of house leads to insanitary and unhygienic conditions leading to dust accumulation.

Dust accumulation is a natural phenomenon that is cleaned everyday by sweeping of rooms or making of bed. Dust accumulation has serious consequences for human beings and their environment. Accumulation process is often accompanied by heterogeneous assemblage of a variety of products of plant and animal origin, an appreciable portion of which is constituted by the HDMs (Laksmi and Haq 1999). HDMs primarily live on dead skin cells, which are commonly called dander, which shed regularly from humans and their animal pets (Barbogg 2003).

Carpets, mattress and upholstered furniture or the places near the human rest, provide suitable conditions for the presence of HDMs in indoor household environment (Mahmic et al. 1998; Warner et al. 1999; Fernandez and Caldas 2002; David 2007).

HDMs have been widely viewed as the most important source of indoor allergens in house dust by Institute of Medise, Washington (Salvatore 2001). They cause various health hazards to the inmates of the family. The best known illness associated with the mites appears to be atop syndrome, asthma rhinitis and other various types of respiratory and skin diseases. These diseases lead to various complications such as frequent ear infection, drowsiness, sinusitis and / or nasal polyps, anaphylaxis, disruption of life cycle, children breathe through mouth, facial changes and skin rashes. This research has been undertaken with the following objectives:

1. To study the housing conditions responsible for HDMs concentration in house.
2. To assess the respondents' health in relation to severity of HDMs.

METHODOLOGY

The study was conducted in the urban area of Udaipur, Rajasthan. A survey of 120 households was conducted to gather information regarding respondents' family background, housing conditions and health complications faced due to HDMs. Apart from this, emphasis was also made to compare the impact of different human activities based on respondents' livelihood pattern in different zones viz. residential

zone (RZ), commercial zone (CZ) and industrial zone (IZ).

Two gram of settled dust was collected from four different areas of furniture and furnishings of living, dining, bed rooms and kitchen of the house through electric vacuum cleaner. The dust samples were collected in separate polythene bags, were sealed and were taken to the laboratory within 24 hours to count HDMs under binocular microscope. On the basis mean ± SD of HDMs counts, all the households were divided into three categories as low (L), moderate (M) and high (H) HDMs. Apart from this, to assess the health status of the respondents due to HDMs complications, health scale was developed which was scored on the basis of scoring technique developed by Jock et al. (1994). Chi square and analyses of variance statistical tests were used to analyse the significant association/ difference between housing conditions and HDMs concentration.

RESULTS

Family Background Information

Family background information of the respondents was collected to analyse the respondents' association with housing factors. Less than two-third (60.83 per cent) of the respondents were from joint families and rest of them (39.17 per cent) were from nuclear families. The average size of the families were five members (SD= 1.44).The average age of respondents' was 45.22 years. One-fourth of the respondents were graduates. More than half of the respondents' were in teaching profession (52.05 per cent) in government and private schools. To assess the socio-economic status of the respondents' families, the worth of the respondents' household assets was calculated. The average worth of respondents' household assets was 19,52,452.00 (SD=15,96,698.00). Data shows that average annual income of the respondents' household was 4,82,158.43 (SD=2,26,173.14).

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 (Lau et al. 1990; Hart 1998). This aspect deals with the respondents' housing information such as orientation of house, type of house, age of house constructed, building material used, situation of the house, occupancy in the house and size of the dwelling. It reflects the zonal difference in the housing conditions of the respondents' which affect HDMs growth. Much of the information related to housing was obtained through qualitative technique that is, participant observation.

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 radiation. The access or lack of these factors through different directions may leads to the growth of micro-organisms in homes (Mahamic and Tovey 1998; Lakshmi and Haq 1999; Rao and Subrahmanyam 2004).

In Table 1 predominance of west oriented houses (35.00 per cent) were 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 CZ and north (45.00 per cent) in IZ. Orientation of respondents' houses in south direction was lesser in CZ (10.00 per cent) and RZ (7.50 per cent). Moreover, orientation of respondents' houses in east direction was lesser (10.00 per cent) in IZ. Intra zonal variation revealed that cent per cent of the RZ respondents' houses fall in higher HDM category had east oriented houses.

Near about two-thirds of the respondents' houses from CZ and IZ were west oriented which falls in higher HDM category. North oriented houses were more in IZ and east oriented in RZ, thus these houses will have morning sunlight. Orientation of house is related with solar radiation which is helpful in killing microorganisms.

Condition of the House

Condition of the house is an important determinant for prediction of HDMs in house (Ginger et al. 1998). Tabulated data clearly highlights that majority (93.33 per cent) of the respondents' houses were *pacca*. A meagre percentage (6.66

Table 1: 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*	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
	North	0	11.10	0	7.50	11.10	12.00	0	10.00	25.00	22.60	0	20.40	12.50
	South	50.00	29.60	100.0	40.00	0	12.00	16.70	10.00	25.00	9.70	0	10.00	20.00
	East	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
	West													
2	*Condition of the House*	10.00	11.10	0	10.00	11.10	8.00	16.70	10.00	0	0	0	0	6.66
	Katcha-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
	Pucca													
3	*Type of House*	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
	Attached	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
	Detached	30.00	18.50	0	20.00	0	0	0	0	0	22.60	20.00	20.00	13.33
	Apartment													
4	*Number of Storey*	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
	Ground floor	60.00	66.70	0	60.00	44.40	32.00	0	30.00	0	0	0	0	30.00
	First floor	0	0	0	0	22.20	36.60	83.30	40.00	25.00	6.50	20.00	10.00	16.66
	Second floor													
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

NS - Non- significant *Significant at 0.05 level of probability

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 IZ because most of them were living in industrial houses. A meagre percentage (10.00 per cent) of respondents' houses was *katcha-pacca* in RZ and CZ which was due to very old construction and parental property. Cent per cent of the higher HDM category respondents' had *pacca* house in RZ and IZ. Only a meagre percentage (10.00 per cent) of the lower HDM category respondents' had *katcha- pacca* houses in RZ. Thus, it can be said that most of the respondents' belonged to higher HDM category had *pacca* houses. It can be said that along with suitable environmental conditions, old and new house (*pucca*) buildings had greater risk of the accumulation of HDMs in home environment (Sharma et al. 2009; Arlian et al.1979; Arlian 1989). The hooks and corners in the *pacca* walls also are the hub of HDMs

Type of Houses

Type of house or accommodation is the important factor in limiting mite population growth (Warner et al. 1999; Rae et al. 2002). Figure 1 shows that half of the respondents' had detached houses whereas 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). Perusals of zonal data distribution showed that majority of the respondents were having attached (80.00 per cent) houses in CZ. This can be attributed to the fact that houses in these areas were very old and made without proper planning. Dominance of detached houses was found in RZ (70.00 per cent) and IZ (60.00 per cent). Zonal variation depicts lower number (10.00 per cent) of attached houses in RZ. Only one- fifth of the respondents were having attached houses in CZ and apartments in RZ. Cent per cent of RZ respondents falling in higher HDM category had detached houses. Hesselnar et al. (2005) also reported that in detached houses risk of HDM developed diseases were high. Moreover, Wickman et al. (1991) also found similar findings that concentration of mites was higher in detached houses (median 42/gm dust) than in flats (median 8/ gm dust). This can be said that detached houses have more open area hence more exposure to outer environment pollutants like dust, microorganisms etc. which leads to more indoor pollution hence there is a greater risk factor in disease development through HDMs. In CZ majority of the respondents' of higher HDM category (83.03 per cent) had attached houses. In CZ houses lack setbacks and were congested at the same time heavy traffic of pedestrian and vehicular for commercial activities leads to pollution. Interestingly in IZ, three- fourth of the respondents belonged to lower HDM category and had detached houses.

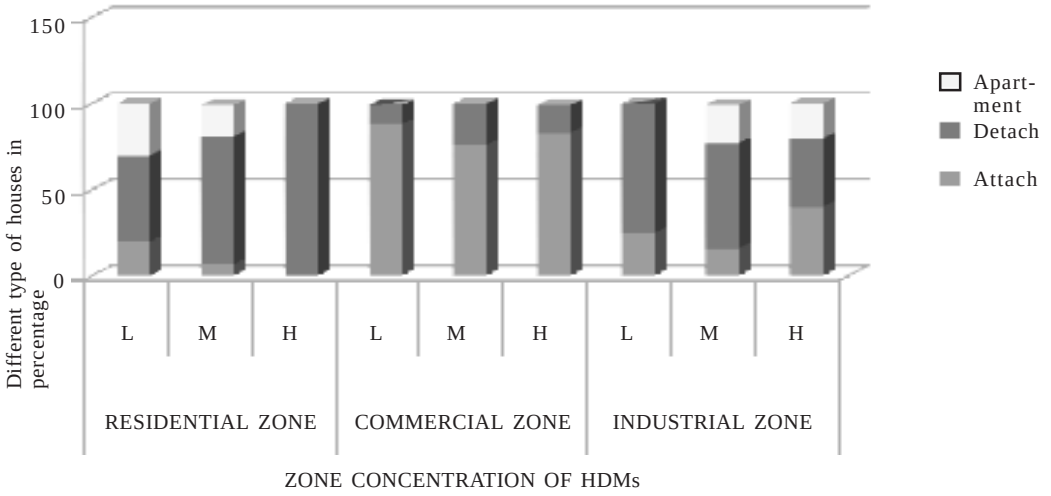

Fig. 1. Type of house in relation to HDMs

Number of Storeys

The concentration of HDMs is influenced by physical factors such as structure and material of house, number of storeys in the house etc. (Saha et al. 1997). 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) resided on the second storey of the house. Majority of the respondents (90.00 per cent) resided on ground floor in IZ and 60.00 per cent on first storey in RZ. Forty per cent of the CZ respondents' houses were on the second storey. It was due to the commercial area of the city having shops on the ground floor and houses on the second storey. These areas are quite congested also (Bency et al. 2003). Variation among each zone showed that cent per cent of the respondents' of high HDM category in RZ reside on the ground floor of the house. Ground floor houses serves as suitable ground for the HDMs growth due to dampness leading to more RH (Wickman et al. 1991; Warner et al. 1999). Majority of the respondents (83.03 per cent) in the higher HDM category reside on the second storey in CZ. However, overwhelming majority (93.55 per cent) of the moderate HDM category respondents in IZ reside on ground floor houses. This can be related to ground level dust can be easily carried indoors through feet and air flow and settles in furniture, furnishings, floor etc. Wickman et al. (1993) also support these findings that higher number of HDMs were found from beds located on the ground floor as compared to mattress dust from upper floor. Number of storey is determining factor of indoor settled dust. A significant association was found between number of storey in the house (χ^2=11.45, df 0.05) and HDMs.

Age of the Houses

Age of the house is an important factor which influences the HDMs 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 CZ (43.47 years) as compared to IZ (39.07 years) and RZ (24.92 years). High HDM category respondents' were having higher than the average age of their houses belonged to RZ (34.33 years) and IZ (39.20 years). Higher concentration of mites in older houses was due to greater chances of settled dust and food material accumulation. Due to oldest houses of CZ, HDMs concentration was found high apart from commercial activities, vehicular and pedestrian pollution. Several studies also reported corroborated findings that older houses especially more than 10 years old favour the multiplication of mite population than the newly built houses (Dixit and Mehta 1973; Tripati and Parikh 1974; Murton and Modden 1977; Mulla and Medina 1980; Korsgaard 1983; Tilak and Jogdand 1989; Modak and Saha 2002).

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 was 18.75 years (SD= 12.79). Table 1 highlighted that respondents' average house occupancy period was more in CZ (30.20 years, SD=9.46 years) than other zones RZ (15.30 years) and IZ (9.75 years). In CZ average house, occupancy period was higher (34.50 years) among high HDM category respondents (Fig. 2). More accumulation of dust and food particles with the increased period of house occupancy leads to proliferation of HDMs. Hence, it can be concluded that higher the period of occupancy in particular house, more the concentration of HDMs (Rae 2002). Bronswijk (1981) also testified the results that colonisation of a new house with dust mites take more than a year and numbers may continue to increase for up to ten years due to accumulation of dust. Analysis of variance also showed significant difference between indoor HDMs concentration and period of house occupancy (F= 1.72, sig. level 0.05). In CZ also significant variation was found between indoor HDMs concentration and period of house occupancy (F= 2.82, sig. level 0.05). In this zone respondents were having family business nearby therefore residing in their houses for generations.

Situation of the House

Accumulation of dust is the most significant factor for the growth of HDMs. It depends upon

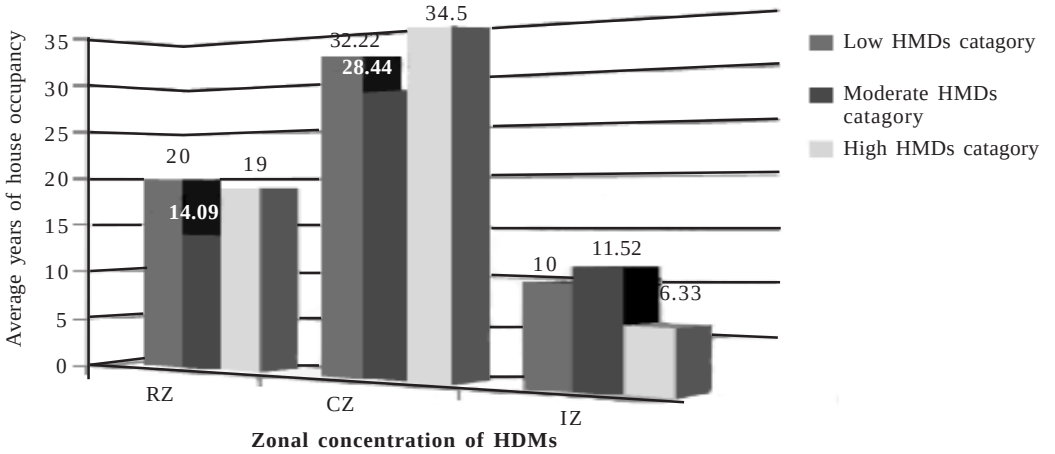

Fig. 2. Period of house occupancy in relation to HDMs

the house situation (Morawaska and Salthammer 2003; Thatcher et al. 1995). The data in the 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 meagre percentage (13.33 per cent) of the respondents houses were situated on the corner of the main road. Thirty per cent of the respondents in CZ and 40.00 per cent in RZ respondents' houses were situated on the main road. These houses had more chances of dust accumulation through road traffic and outer pollution which creates favourable conditions for HDMs concentration. In RZ, cent per cent of the higher HDM category respondents' houses were situated inside the street. However in CZ, 66.07 per cent of the higher HDM category respondents' houses were situated on the main road which causes greater indoor dust accumulation and with suitable environment conditions it leads to HDMs growth. People living on the main road were too much exposed to outdoor dust and related problems (Bency etal. 2003). On the main road, commercial activities and vehicular transportation were the main cause of indoor pollution. Furthermore, in CZ 66.70 per cent of the lower HDM 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 (Bency et al. 2003). Apart from the kitchen, other storage and service areas, number of rooms in the respondents' house include living, dining and bed room. Most of the respondents' houses were of four (53.33 per cent) rooms (Table 1). 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 the four rooms in the house. Intra zonal variation revealed that cent per cent of the RZ respondents' living in more than four rooms houses had higher concentration of HDMs. Increased space in the house needs proper cleaning from hygienic point of view. Improper cleaning accumulates dust in the house and causes the problems of HDMs. Sixty per cent of the respondents in IZ who had four rooms in their houses fall in higher HDM category.

Dampness and Cracks in the House

Dampness and cracks in the house affects the health and comfort of the occupants (Rao and Subrahmanyam 2004). Dampness in the house is one of the favorable factors for the growth of HDMs among households. Zock et al. (2002) in a study investigated the clear association between asthma and housing dampness as well as mould exposure and HDMs.

Dampness: Concentration of HDMs is influenced by the condition of house like dampness or cracks in the house (Saha 1997; Zock et al. 2002). The dampness in the building creates unhealthy living conditions and at the same time

Table 2: Distribution of respondents' according to presence of dampness, cracks, ventilation and pets in their house

S.No.	Dampnessand cracks	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	Grand total N=120
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		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	12.90	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	45.20	0	15.00	21.66
d	Kitchen	30.00	14.80	0	17.50	11.10	18.00	0	7.50	25.00	9.70	20.00	30.00	18.33
e	Bathroom	30.00	29.60	33.30	30.00	0	32.00	16.70	22.50	0	32.30	60.00	27.50	26.66
	χ^2-value				2.66^{NS}				2.29^{NS}		25.80		3.56^{NS}	10.77^{**}
2.	*Cracks in the House*•													
a	Living	0	14.80	33.30	12.50	11.10	12.00	50.00	10.00	25.00		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	29.00	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	12.90	0	2.00	16.00
e	Bathroom	20.0	18.5	33.3	20.0	22.2	32.0	33.3	30.0	0	0	40.0	27.5	25.83
4.	*Proper Ventilation*										29.0			
a	Ventilation	60.00	55.60	0	52.50	11.10	60.00	66.70	50.00	75.00		60.00	57.50	53.33
b	Ill ventilation	40.00	44.40	100.0	47.50	88.90	40.00	33.30	50.00	25.00	54.80	40.00	42.50	46.66
	χ^2-value				3.14^{NS}				5.99^{*}		45.20		2.30^{NS}	9.06^{*}
5	*Presence of Pets*													
a	Present	20.00	14.80	66.70	20.00	44.40	36.00	33.30	37.50	50.00		60.00	25.00	27.33
b	Not present	80.00	85.20	33.30	80.00	55.60	64.00	66.70	62.50	50.00	16.10	40.00	75.00	72.63
	χ^2-value				4.57^{NS}				0.25^{NS}		83.90		5.99^{*}	6.57^{*}

• Multiple responses NS Non significant
* Significant at 0.05 level of probability ** Significant at 0.01 level of probability

breaking and cracks of walls and roofs may serve as breeding ground for various type of micro-organisms (Rao 2004). Predominance of dampness in house was observed in the bathroom (26.66 per cent) followed by bedroom (21.66 per cent), living room and kitchen (18.33 per cent) (Table 2). Inter zonal comparison revealed that higher per cent (27.50 per cent) of the respondents in CZ had dampness in living rooms. Respondents' had dampness in kitchen (IZ=30.00 per cent) and bathrooms (RZ=30.00 per cent). In Figure 3 intra zonal variation revealed that one-third of the respondents' of high HDM category had dampness in living rooms, bedrooms and bathrooms. Higher number of respondents' that fall in the lower HDM category in CZ (44.40 per cent) and IZ (75.00 per cent) had dampness in their bedrooms. A significant association was found between the HDMs and overall dampness in the house (x2=10.77, sig. level 0.01). Dampness in the house directly increases the RH of the house which is helpful for HDM growth (Adan et al. 1988; Sharma 2009). Though, Domrow (1970) and Lang and Mulla (1977) found no significant difference in mite concentration between modern dry well built houses and old damp houses. Chronic dampness can increase asthma/ wheezing incidence or morbidity in both children and adults (Ostro et al. 2001; Gent et al. 2002; Lee et al. 2003; Sharma et al. 2009).

Cracks: House dust mites were also found in cracks of the floor and other protected places. Near about half (48.33 per cent) of the respondents' had cracks in their living rooms. A small percentage of the respondents (15.00 per cent) had cracks in dining rooms. More than one- third of respondents (35.00 per cent) in RZ had cracks in their dining room. In CZ, near about one- third of the respondents' (30.00 per cent) had cracks in their bathrooms. More than one- fourth of the IZ respondents' (27.50 per cent) had cracks in their living, dining and bathrooms. In RZ, 40.00 per cent of the respondents' faced cracks problem in their houses and fall in lower HDM category. Respondents' of lower and high HDM category had cracks in dining and bedroom in CZ. Half of the respondents' in IZ had cracks in their kitchen falls in lower HDM category.

HDMs hide in the dust of the cracks because these places are dark and moist. Discover magazine (1998) also upholds similar results that HDMs founds 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 usually relatively moist.

Ventilation: Ventilation means supply of fresh air and removing dust, heat and other pollutants from indoors for human comfort (Rao 2004). Proper ventilation is an important step in household cleaning because a well- ventilated house

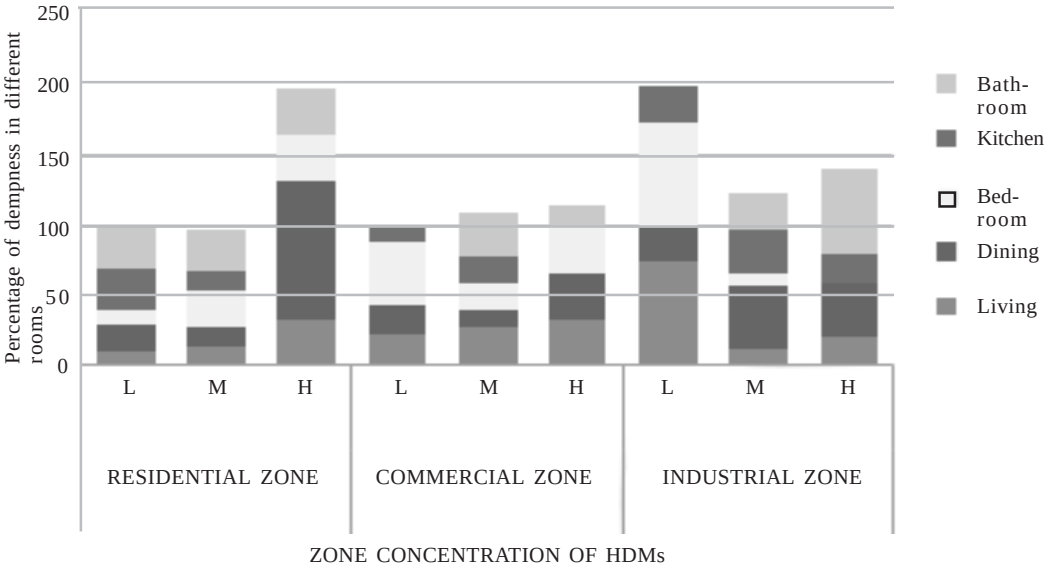

Fig. 3. Dempness in the house in relation to HDMs

can more easily provide the dry conditions that are inimical to house dust mites (Crowther et al. 2000; Ginger et al. 1998; Modak and Saha 2002; Rae et al. 2002). Improper ventilation and faulty cleaning practices are the main reasons for the occurrence of HDMs. Better cleaning practices and proper waste disposal are necessary steps for the control of house dust mites.

Near about half (53.33 per cent) of the respondents' had proper ventilation in their houses whereas the rest (46.66 per cent) of respondents' houses were ill- ventilated (Table 2). More than half (57.50 per cent) of IZ respondents' had ventilation in their houses. Half of the respondents' houses in CZ were ill- ventilated. In this zone that is situated in the centre of the city are densely built up areas (Rao 2004). In this zone attached houses were more thus air circulation was not proper and that creates indoor pollution and accumulation of dust in the house. In RZ, cent per cent of the respondents' belongs to high HDM category had ill-ventilated houses. It was striking to note that in CZ majority (88.90 per cent) of the respondents' belonged to lower HDM category had ill-ventilated houses. Ill- ventilated conditions enhance the exposure of moulds and HDMs that can cause an increased risk on allergic sensation (Beate et al. 2002). Ventilation in the house showed significant asso-ciation with indoor HDMs (χ^2=9.06, sig. level 0.05). Inter zonal difference also had a signifi-cant association (χ^2=5.99, sig. level 0.05) with indoor HDMs concentration in CZ. Due to congested houses there is lack of proper ventilation affecting hygienic condition of the house. These congested houses create assemblage of various types of indoors aerosols; one of the major indoor aerosols is house dust mites (Bency et al. 2003).

Livestock and Pets

Livestock and pets have an important role in spreading allergic diseases in indoors. Pets contribute dander and skin scales in dust which is a good food source for HDMs (Barbogg 2003). Livestock and pets are kept indoors or outdoors.

Pets: Body of pets contains various types of allergens that may transmit various allergic diseasesn (Bronswijk 1981; Cohort 2008). More than one- fourth of the respondents' were keeping the pets along with them. In CZ more number (37.50 per cent) of respondents' kept pets in their house than other zones (RZ= 20 per cent and IZ=25 per cent). Higher per cent of respondents' that were keeping pets in their house in RZ (66.70 per cent) and IZ (60 per cent) belonged to high HDM category. Management of house dust mites can be achieved by physically removing the pets and their food sources and by altering their preferred environment in the house. Chi square values show a significant association with presence of pets in the house and HDMs (χ^2=6.57, sig. level 0.05). Significant association was also found between HDMs and presence of pets (χ^2 =5.99, sig. level 0.05) in IZ. This may be due to concentration of HDMs which develops on skin scales shed by pets.

Effect of HDMs on Health of Respondents

The severity of HDMs complication was scored on four point continuum as never, mild, moderate and severe. On the basis of mean scores ± SD, the HDMs severity of complication scores were divided into three categories as mild, moderate and severe. HDMs are the major cause of all year round complaint of stuffy nose, sneezing and watery eyes which some people describe as a 'permanent cold'. However, there are reports of red rashes around the neck. Other allergic reactions may include headaches, fatigue and depression (Little 2003).

The average severity score of respondents' health status from HDMs was 32.41 (SD=5.93). Data in Table 3 revealed that respondents' of CZ had high average complications scores (33.02) than respondents' of RZ (33.02) and IZ (31.45). Respondents' of RZ that were facing higher complications (32.77) belonged to high HDM category.

HDMs complications scores show that more than the half of the respondents' (51.66 per cent) had moderate HDMs complication scores. Furthermore, 28.33 per cent of the respondents' had mild HDMs complication scorers. One-fifth of the respondents' belonged to high HDM category in IZ (20 per cent) and CZ (16.70 per cent) had severe HDM complications score. Half of the respondents' from IZ and 40 per cent from RZ belonged to lower HDM category had severe HDMs complication scores. Half of all the three zones' respondents had moderate HDMs complications score and it was especially higher among IZ respondents' (80 per cent).

Table 3: Distribution of respondents' according to HDMs complication severity scores

S. No.	HDMs complication scores	RZ				CZ				IZ				Grand total 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	*Mild* (Upto 26.47 scores)	10.00	37.00	33.30	30.00	33.30	32.00	33.30	32.50	50.00	22.60	0	22.50	28.33
2	*Moderate* (26.48- 38.34 scores)	50.00	48.10	66.70	50.00	55.60	52.00	50.00	52.50	0	54.80	80.00	52.50	51.66
3	*Severe* (38.35- 54 scores)	40.00	14.80	0	20.00	11.10	16.00	16.70	15.00	50.00	22.60	20.00	25.00	20.00
	Mean	29.20	33.88	34.66	32.77	33.88	32.88	32.33	33.02	33.25	31.45	30.00	31.45	32.41
	S.D.	5.32	6.20	6.11	6.20	5.94	5.99	6.12	5.86	8.38	5.76	3.74	5.74	5.93

Hence, the severity of HDMs complications were more in IZ which may be due to industrial pollution rate bringing about changes in surrounding aerosol concentration. Constant exposure to mite allergens can lead to chronic illnesses. High exposure to dust mites in infancy has been implicated as a cause of increasing prevalence of asthmatically predisposed allergies - atopics . Furthermore, constant exposure to mite allergens can lead to chronic illnesses (Drees and Jackman 1999).

CONCLUSION

Thus, it can be concluded that improper cleaning of the house leads to insanitary and unhygienic conditions leading to dust accumulation. Concentration of HDMs indoors was influenced by different housing conditions. Dampness, cracks, improper ventilation and presence of pets are the conditions that effect the concentration of HDMs in home and these were found significant in the study. HDMs are very harmful for human health. They are the causative factors for different complications that may occur but homemakers were ignorant about these micro-organisms. Hence, policy framers architects, civil engineers should emphasize on proper planning of houses. They should also device suitable techniques which would reduce dampness indoors. Awareness among homemakers should be generated regarding harmful effect of HDMs which will be helpful in reducing their health problems.

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