Original Research Article

A longitudinal study on the association between water storage practices and dengue indices among rural households of Chengalpattu district, Tamil Nadu

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ABSTRACT

Background: The abundance of *Aedes* mosquitoes which transmits dengue fever fluctuates with unusual rainfall pattern and water storage practices, as it breeds well in artificial collections of water in and around the houses so vector control is the only way to break the chain of disease transmission. This study aims to find out the association between water storage practices and mosquito larval indices.
Methods: This was a longitudinal study conducted among 121 households in the rural field practice area of SRM Medical College and Research Centre using a pretested, semi-structured questionnaire along with visual inspection of households for water collection and larval breeding.
Results: Total study population in the 121 households was 484 which includes 247 (51%) males and 237 (49%) females. Majority of the study population were illiterates 23.7% or have education upto high school 20.8%, doing semi-skilled/unskilled work 32% belonging to a nuclear family 69.4%. More than half of the households were living in pucca house 50.4% and belongs to class-II socio-economic status 46.3%. Water scarcity and water storage were reported mostly in months between March to June which was significantly associated with presence of larva in the corresponding months (p<0.001).
Conclusions: Water storage practices due to water scarcity has a significant association with the larval indices which shows that improper water storage practices can be a breeding place for mosquitoes and aid in transmission of vector borne diseases.

Keywords: Water storage, Dengue indices, Mosquitoes

INTRODUCTION

Safe water and access to the same is a felt need of the community and it is estimated by World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) that 1.1 billion people lack access to improved water supplies.[1] Water storage and collection for human related activities may result in number of potential breeding sites which may reflect on the burden of vector borne diseases. The abundance of Aedes mosquitoes which transmits dengue fever fluctuates with unusual rainfall pattern and water storage, as it breeds well in open containers in and around the houses and vector control is the only way to break the chain of disease transmission.[2]

Aedes aegypti which transmits dengue fever breeds and develops in artificial containers of small volume, viz.,

flasks, bottles, flower vases, tin cans, jars, discarded automobile tyres, unused water closets, cisterns, rain barrels, sagging roof gutters; whereas Aedes albopictus breeds in coconut shells, snail shells, leaf axils and tree holes.[3] Aedes aegypti a domestic mosquito is extensively found in urban environment, mainly in residential areas with close and congested proximity.[4] Entomological surveillance based on three different larval indices namely the house index (HI) (percentage of houses infested with larva or pupa), container index (CI) (percentage of water holding containers with larva or pupa) and Breteau index (BI) (number of positive containers per 100 houses inspected) have become widely used indices, but their critical threshold has never been determined for dengue fever transmission.[5,6] This study aims to find out the association between water storage practices and the three different larval indices so that potential breeding places can be removed through health education.

METHODS

A longitudinal study was conducted between September 2018 and August 2019 (1 year) in the rural field practice area of SRM Medical College Hospital and Research Centre, Chengalpattu district, Tamil Nadu which consists of totally 9 villages and 3270 households. Based on the study by Balasubramaniam et al with house index of 17, using the formula $4pq/d^2$ with d=7.5, the minimum required sample size calculated was 100.[7] Adding 20% to the estimated sample size to account for attrition (lost to follow up) the final sample size was calculated to be 121. All the households in the study area were taken as individual sampling units (1 sampling unit = 1 household). Following institutional ethical committee clearance, necessary permission from the respective village heads and the list of households in the study villages were obtained. Using PPS, the sample size of 121 households was distributed among the 9 villages in the study area and systematic random sampling was used to select the individual households from the respective villages till the required sample size of 121 was achieved. Locked households, non-residential dwellings, and those who didn't give consent were not included in the study.

Data collection tools include a pre-tested, semi-structured questionnaire as well as materials for visual inspection of households (torchlight, magnifying lens and scoop). After obtaining written informed consent the data was collected from adult respondents who were available in the house at the time of visit. Date collected includes the baseline socio-demographic profile of the household, details regarding water storage practices, and visual inspection findings of household (for breeding of mosquitoes in water collections) using magnifying lens, scoop and torchlight. All the 121 households included in the study were visited every month during the study period and information on the water scarcity and water storage practices were collected. In case if the house was locked

at the time of visit the same house was visited again in the same month to collect the required information.

Data collected were entered in Microsoft excel spread sheet and analyzed using SPSS software version 22. Descriptive statistics was used for socio-demographic profile of the study participants in which modified BG Prasad scale 2019 was used to assess the socio-economic status of the study participants and chi-square test was to use to find out the association between water storage practices and dengue larval indices.[8] A p value <0.05 was considered to be statistically significant.

RESULTS

The study population consists of 121 households with 484 individuals out of which 248 were males (51%) and 237 were females (49%). Almost three-fourth of the study participants in the households were in the age group of 15 to 60 years (73%). Majority of the study population were illiterates (23.7%) followed by having education upto high school (20.8%) and primary school (17.7%). More than half of the family members were unemployed (51%) and others mostly involved in semi-skilled (16.1%) and unskilled (15.7%) type of occupation. According to modified BG Prasad scale 2019, majority of the families surveyed belonged to socio-economic class-II (46.3%) followed by class-III (21.5%) and least belonged to class V (5%). Most of the families were living in pucca house (50.4%) followed by semi-pucca (38.8%), kutcha type of houses (10.7%) and about two-thirds of the study population belongs to a nuclear family (69.4%) followed by joint family (22.3%). Majority of the households in the villages depend on the village panchayat water supply (91.7%) for their domestic water demand and only few households 8% have other source of water supply (wells, bore-well etc.,). More than half (56.3%) of the households surveyed were doing water storage practices in their households throughout the year. Among households who stored water only 81% practiced covered water storage, mostly using solid or perforated lids and remaining 19% of the households used to store water in open containers/vessels till consumption (Table 1).

Table 2 shows that in the study area water storage practices are followed in at least 40% of the households irrespective of water scarcity and this storage increases to a maximum of around 90% during the summer months (March to June) when the water scarcity in the households increased multiple times upto 95% from the usual level of less than 3%. The water scarcity and the water storage practices were found to be significantly associated with the presence of larva in the households during the corresponding months with a p value of <0.001.

Figure 1 shows that comparison between the water scarcity and water storage with the various larval indices. From the line diagram it is evident that the water scarcity and water storage gradually increases during the summer

seasons between the months of March to June and then decreases once the monsoon starts. Data from the households surveyed in the study area shows that all three larval indices (House index, Breteau index and container index) show two common peaks over a period of one year, first between the months of October to December and the second peak in all three indices occur between the months of June to August.

Table 1: Socio demographic profile of the study participants (n=121 households/484 individuals).

| Socio-demographic characteristics		N (%)
Age in years	<15	85 (17.6)
	15-60	353 (72.9)
	>60	46 (9.5)
Sex	Male	247 (51.1)
	Female	237 (48.9)
Literacy	Illiterate	115 (23.7)
	Primary	86 (17.7)
	Middle	65 (13.5)
	High	101 (20.8)
	Higher secondary	49 (10.1)
	Graduate	63 (13.1)
	Professional	5 (1.1)
Occupation	Professional	7 (1.4)
	Clerical	40 (8.2)
	Semi-skilled	78 (16.1)
	Skilled	36 (7.4)
	Unskilled	76 (15.7)
	Unemployed	247 (51.3)
Socio-economic status (n=121) (modified BG Prasad scale 2019)	Class I	14 (11.6)
	Class II	56 (46.3)
	Class III	26 (21.5)
	Class IV	19 (15.7)
	Class V	6 (5.0)
Type of family (n=121)	Nuclear	84 (69.4)
	Joint	27 (22.3)
	Extended	10 (8.3)
Type of house (n=121)	Pucca	61 (50.4)
	Semi-pucca	47 (38.8)
	Kutcha	13 (10.7)
Source of water (n=121)	Well	1 (0.8)
	Bore well	3 (2.5)
	Panchayat water	111 (91.7)
	Others	6 (5)
Water storage practices among study participants		
Water storage n=1452 (121×12)	Yes	817 (56.3)
	No	635 (43.7)
Covered water storage (n=817)	Yes	662 (81)
	No	155 (19)
Type of cover used (n=662)	Solid lid	366 (55.3)
	Perforated lid	280 (42.3)
	Cloth cover	16 (2.4)
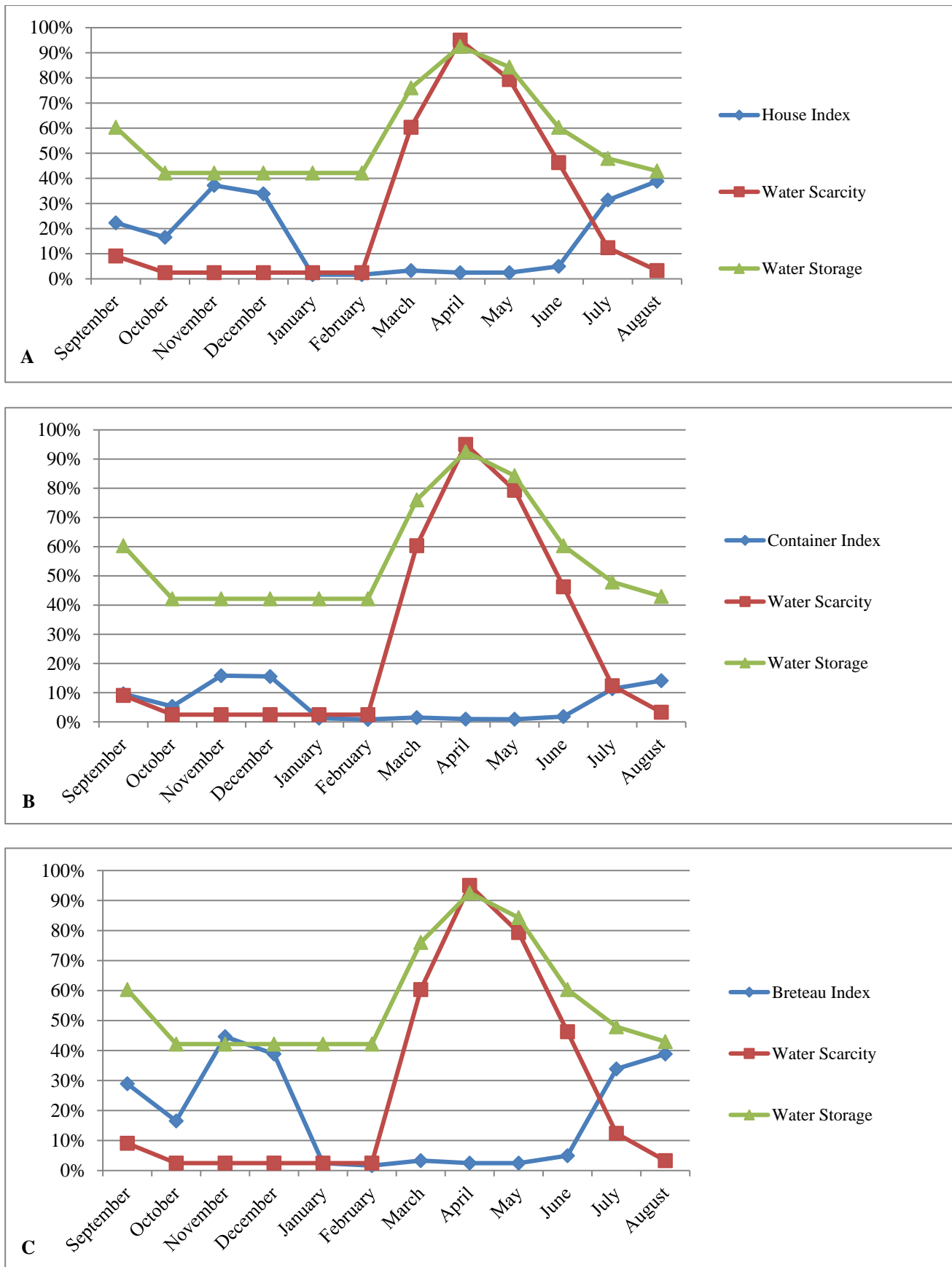
Figure 1: Line diagram showing the comparison of water scarcity and water storage practices with (A) house index, (B) container index and (C) Breteau index.

Table 2: Association between water scarcity and water storage practice with the presence of larva in the households (1-year follow-up) (n=121).

Month (with larva)	Water scarcity in past one month		Chi-square	P value	Storage of water		Chi-square	P value
	Yes N (%)	No N (%)			Yes N (%)	No N (%)		
September'18	11 (9.09)	110 (90.91)			73 (60.33)	48 (39.67)		
October'18	3 (2.48)	118 (97.52)			51 (42.15)	70 (57.85)		
November'18	3 (2.48)	118 (97.52)			51 (42.15)	70 (57.85)		
December'18	3 (2.48)	118 (97.52)			51 (42.15)	70 (57.85)		
January'19	3 (2.48)	118 (98.33)			51 (42.15)	70 (57.85)		
February'19	3 (2.52)	118 (98.33)	805.687	<0.001	51 (42.86)	70 (57.14)	185.021	<0.001
March'19	73 (60.33)	48 (39.66)			92 (76.03)	29 (23.96)		
April'19	115 (95.04)	6 (4.96)			112 (92.56)	9 (7.44)		
May'19	96 (79.34)	25 (20.66)			102 (84.3)	19 (15.7)		
June'19	56 (46.28)	65 (53.72)			73 (60.33)	48 (39.67)		
July'19	15 (12.4)	106 (87.6)			58 (47.93)	63 (52.07)		
August'19	4 (3.30)	115 (95.04)			52 (42.97)	69 (57.02)		

DISCUSSION

The present study was carried out among 121 households in the rural field practice area of SRM Medical College and Hospital to assess the relationship between water storage practices and dengue larva indices.

In the present study most of the study participants belonged to class II socio-economic status whereas in a study conducted by Chellaiyan et al in a rural area of Kanchipuram, class I socio-economic status was more and in another study conducted by Krishnamoorthy et al class IV socio-economic status population were more in number.[9,10] With respect to type of house in the study area people living in kutcha houses was around 10.7% and 50.4% were living in pucca house, but in contrary semi-pucca was the common type houses in rural India according to NFHS-4.[11]

The study shows that the water storage practices is more during the summer seasons when there is water scarcity. Majority of the households get their water supply from the panchayat water supply which comes twice daily for two hours each time, but during summer seasons the duration of water supply or the frequency of water supply varies and mostly it reduces. This mandates the need for storage of water to satisfy the needs of the household. Similar results were found in a study by Betancourt et al where scarcity of water and high price of water during scarcity times were said as a reason for storage of water.[12]

When there are instances of water scarcity which happens mostly during dry seasons, there will be no artificial collection of water generally, even then there was a rise in the larval indices though not as much as when compared to the months in which usually monsoon arrive every year. This may be due to the practice of storing water for a longer duration which might have favored the breeding of mosquitoes. During months of water scarcity, the requirement of water increases, so the storage as well as the duration of storage also increases. As during these seasons there will be storage of water in many number of containers and the ones that are frequently used will be again refilled and used the ones that are not used regularly where storage is done to handle the excess scarcity which happens during these seasons would be kept as such, may turn into a favorable breeding place for mosquitoes to complete their life cycle which usually takes around a week to develop from eggs to adults. The first peak in larval indices between October to December may be due to artificial collection of water after the monsoons and the second peak between June to August may be due to the longer duration of water storage practices that is followed during the summer season.

We found a strong association (p<0.001) between the water scarcity and water storage practices followed with the presence of larva in the households surveyed. This significant association between water storage practices due to water scarcity with the larval indices shows that the breeding of mosquitoes within the households can be controlled by adapting proper water storage practices during times of scarcity.

Limitation

Although we found a significant association between the water storage practices during the scarcity period with the various dengue indices we couldn't able to exactly differentiate between the indices which was positive due to water storage because of scarcity and artificial collection of water by other means like rainfall, gardening etc., So future studies can be done by addressing to this issue to get a clear picture on the effect of water storage due to scarcity in the transmission of vector borne disease.

CONCLUSION

Water storage practices due to water scarcity has a significant association with the larval indices which shows that improper water storage practices can be a potential breeding place for mosquitoes and aid in transmission of vector borne diseases. So, health education regarding the proper water storage practices should be imparted to the public wherever there is a necessity to store the water during the scarcity period. This will help in eliminating the breeding places of vectors thereby prevent the spread of vector borne disease and improve the general well-being of the community.

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