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Changing Domesticity of *Aedes aegypti* in Northern Peninsular Malaysia: Reproductive Consequences and Potential Epidemiological Implications

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Abstract

Background: The domestic dengue vector *Aedes aegypti* mosquitoes breed in indoor containers. However, in northern peninsular Malaysia, they show equal preference for breeding in both indoor and outdoor habitats. To evaluate the epidemiological implications of this peridomestic adaptation, we examined whether *Ae. aegypti* exhibits decreased survival, gonotrophic activity, and fecundity due to lack of host availability and the changing breeding behavior.

Methodology/Principal Findings: This yearlong field surveillance identified *Ae. aegypti* breeding in outdoor containers on an enormous scale. Through a sequence of experiments incorporating outdoors and indoors adapting as well as adapted populations, we observed that indoors provided better environment for the survival of *Ae. aegypti* and the observed death patterns could be explained on the basis of a difference in body size. The duration of gonotrophic period was much shorter in large-bodied females. Fecundity tended to be greater in indoor acclimated females. We also found increased tendency to multiple feeding in outdoors adapted females, which were smaller in size compared to their outdoors breeding counterparts.

Conclusion/Significance: The data presented here suggest that acclimatization of *Ae. aegypti* to the outdoor environment may not decrease its lifespan or gonotrophic activity but rather increase breeding opportunities (increased number of discarded containers outdoors), the rate of larval development, but small body sizes at emergence. Size is likely to be correlated with disease transmission. In general, small size in *Aedes* females will favor increased blood-feeding frequency resulting in higher population sizes and disease occurrence.

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Introduction

Aedes aegypti is a common domestic vector mosquito, which lives in close association with and shows a preference for feeding on humans, even when other hosts are available [1,2,3]. It is considered one of the world's most important mosquito vector species because of its high degree of susceptibility to virus infection [4] and is an efficient epidemic vector of several human diseases, including dengue fever, Chikungunya, and yellow fever [5,6]. *Ae. aegypti* is a complex species with a combination of sylvan and domestic forms [7,8]. The latter form originated in North Africa from the South African sylvan form during the expansion of the Sahara Desert [9]. This domestic form was transported to the rest of the world through trade and shipping during the 15th–19th centuries. This form has maintained its domesticity up to 83% in East Africa [10]. Moreover, this is a common domestic mosquito in tropical and subtropical countries [11]. However, in a yearlong survey in the Northern peninsula of Malaysia performed in 2009, more than half of the immature *Ae. aegypti* were collected from outdoor containers. Many of those containers were away from human dwellings, *e.g.*, near roadside food stalls. The acquisition of this outdoor breeding or peridomestic adaptation together with indoor breeding behavior can potentially increase the biting activity of this vector species both indoors and outdoors, which may have important implications for disease transmission. Despite its epidemiological importance, there have been no previous studies regarding this issue in relation to the dengue vector *Ae. aegypti*.

The number of gonotrophic cycles (GCs) of a vector is an indicator of its survivorship, the biting frequency as it bites at least once in a single GC [12], and fecundity [13]. These are also the primary components of the epidemiology of dengue. Fecundity is dependent on reproductive success, which is closely related to body size. Several studies have established a relationship between mosquito size and fecundity in that large females have higher fecundity rates than smaller individuals [14,15]. The later individuals have been reported to be frequent biters [2], and the biting rate of a vector population is a major indicator of parasite and pathogen transmission [16]. The mosquito's habit of taking more than one blood meal per GC [3,17,18] can markedly