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Home Environmental Factors with the Presence of Disease Transmission Mosquito Vectors in Traditional Villages, Indonesia

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Abstract

Indonesia is an archipelagic country that has many tribes and traditional villages. This makes the variables that affect the presence of disease-transmitting mosquito vectors very complex. This study aims to observe traditional villages in arranging community-housing patterns that have the potential for mosquito-borne diseases. The study used a cross-sectional design with a sample of 67 houses in Segenter Village, employing a simple random sampling method for sampling technique. The results found that the determining factor associated with the presence of disease-transmitting mosquitoes is the location of the kitchen outside the house (Exp β= 2.340). These factors are reinforced by the presence of foodstuff storage room (bale inan) (Exp β= 2.140), the absence of an insulating door in the house (Exp β= 2.130), the location of the bathroom outside the house (Exp β = 1.912), the roof of the house made of woven (Exp β= 1.764), traditional house type (Exp β= 1.650), mixed house type (Exp β= 1.413), and wicker house walls (Expβ= 0.113). These factors contribute to 77.79% of the presence of disease-transmitting mosquito vectors in traditional villages. The results of this study can be used to develop an early warning system and promote health tourism through a house-screening program.

INTRODUCTION

Vectors are animals that carry and transmit diseases from infected humans to other humans through bites, feces, contaminated food, and body fluids (Seventer & Hochberg, 2017). Mosquitoes are the main insect vectors that cause various tropical diseases in Indonesia. The number of mosquito species in Indonesia, as summarized by O'Connor & Sopa, is noted to be 456 species from 18 genera distributed throughout the country (Nugroho & Mujiyono, 2021). Vector species that have the potential to cause several vector-borne diseases in Indonesia are Malaria, Dengue Fever, Filariasis, Chikungunya, and Japanese Encephalitis (JE). These diseases have high morbidity and mortality rates, so they have the potential to cause outbreaks (Paixão, et al., 2018).

Mosquito-borne diseases depend on complex interactions between the environment, population susceptibility, exposure, and adaptive capacity (Kissler et al., 2020). Variations in climatic factors, such as temperature and rainfall, can also influence the spatiotemporal distribution of vectors, hosts, and pathogens (Kissler et al., 2020). The presence of climate change has raised concerns over the increased transmission of mosqui-

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to-borne diseases. This is due to factors such as heightened vector survival and bite rates, amplified replication of pathogens within vectors, shorter reproduction cycles, and extended transmission seasons (Mordecai et al., 2019). The presence of climate change has raised concerns over the increased transmission of mosquito-borne diseases through factors such as heightened vector survival and bite rates, amplified replication of pathogens within vectors, shorter reproduction cycles, and longer transmission seasons. Gradually, the diseases are starting to appear in areas that were previously unaffected and are making a comeback in regions that have seen a decline in cases for decades (Leedale et al., 2016), (Watts et al., 2019). The results in Ecuador show that the presence of Ae. aegypti at the household level at coarse temporal scales is driven by climatic factors (Martin, et al, 2021).

Indonesia is an archipelagic and transcontinental country located in Southeast Asia. It is a tropical country where the main mosquito vectors, Aedes aegypti, Aedes albopictus, Anopheles, and Culex, are endemic in almost all areas (Harapan et al., 2019). As an archipelagic country, Indonesia had 1,331 tribes and 133 traditional villages by 2021 (BPS, 2022), this makes the variables affecting the breeding and production of mosquito vectors numerous and complex (Arunachalam et al., 2010) because each tribe and custom has different characteristics, several recent studies show that modern, well-built housing can be protective in many tropical countries (Wanzirah et al., 2015) and simple features, including covered roofs, brick walls, tile or metal roofing, and ceilings, can reduce the entry of mosquitoes into your home (Anderson et al., 2014). However, the types of community houses in Indonesian Traditional Villages vary greatly, such as traditional houses, mixed houses, and modern houses, so screening of the home environment is necessary as an effort to determine the contribution to the Aedes vector control program. Home screening is the first intervention to be trialed in Italy after a link between malaria and mosquitoes was discovered (Tusting et al., 2015). Home screening was later shown to reduce the risk of malaria in India, South Africa, and the United States (Anderson et al., 2014). Additionally, better housing contributed to malaria elimination in the United States and Europe (Hackett & Missiroli, 1932).

To date, there have been no studies examining the presence of disease-transmitting mosquito vectors in traditional villages. One of the traditional villages in Indonesia is located on the island of Lombok, namely the Segenter Traditional Village. Segenter Traditional Village is one of the residential areas that still adhere to local customs and is oriented towards macro and microcosmic beliefs in arranging the layout and direction of the house. This village has the characteristics of a simple traditional house with walls made of woven bamboo, thatched roofs, wooden house supports, no ventilation, windows, and a dirt floor, making the traditional environment likely to have the potential for mosquito-borne diseases in the area. Several previous studies have shown that the number of mosquitoes is higher in houses with open roofs, thatched roofs, mud walls, and unprotected windows (Kaindoa et al., 2018), (Carrasco-Tenezaca et al., 2021), (Ondiba et al., 2018). The purpose of this study is to assess the condition of houses in traditional villages that have the potential for the presence of disease-transmitting mosquitoes. Describing the characteristics that influence vector presence within customary areas may help in developing intervention strategies tailored to meet the challenges of delivering effective mosquito control in a unique social-ecological system in Indonesia.

METHOD

Location and Time of the Research

This research was conducted in February-April 2022, and it took place in Segenter Traditional Villages, North Lombok, West Nusa Tenggara. The village is located in Sukadana, Bayan District (8oLS14' 17'' dan 116oBT22' 44''). Lombok Regency is one of the regencies in NTB, which, from a regional point of view, has become a point of economic development and a tourist destination because of the local culture in the form of a traditional environment that is still being preserved by the community, one of which is the Segenter Traditional Villages. The Sasak community has traditional rules in the form of beliefs in ancestral traditions that then influence the behavior and patterns of community settlements inhabiting this village. Each rule has a meaning that contains the value of obedience to teachings and norms in people's lives.

Study Design and Sample

This study used a cross-sectional design with samples coming from houses in Segenter Traditional Villages. The number of samples was determined based on the random survey formula (Ogston et al., 1991) with $\beta = 0.05$, so 67 houses were selected. Each house was randomly chosen using a table of random numbers, with a sampling frame in the form of a list of houses owned by traditional leaders or regional leaders.

Entomology Survey

A team of two tropical medical students, trained in adult mosquito collection using aspirators, visited each home. The sampling sequence was as follows: One surveyor entered the house and collected resting mosquitoes in all rooms, including the kitchen and bathroom, for 15 minutes. A timer was used to ensure collection ended every 15 minutes. Paper cups containing mosquito collections from the first surveyor were given to the supervisor. The second surveyor went into the house to collect adult mosquitoes for the next 15 minutes. This collection lasted 3 hours in two consecutive rounds. Supervisors were team members who were familiar with the sample collection process for each round. This procedure is a blinded method for surveyors to minimize information bias. We chose a 3-hour sampling time as it aligns with the total duration of sampling from several previous studies (P. Manrique-Saide et al., 2014), (Koyoc-Cardeña et al., 2019). During collection, each paper containing mosquitoes was labeled with the house code and collection serial number. All collected mosquitoes were transferred to the laboratory and placed in a freezer at 20°C for 10 minutes. The identification of mosquito species was carried out based on key standards from the WHO (WHO, 2020). Officers responsible for collecting mosquito vector data are entomologists at public health centers and master students majoring in tropical medicine who have received training in mosquito collection.

Physical Environment

Physical environment data were collected from each household selected as a sample using observation guidelines. Observations on the physical condition of the houses consisted of the following variables: 1) Type of house: traditional houses, mixed houses, and modern houses (Sujarwo, 2019), (Supiyati et al., 2019); 2) House floor materials: ceramic or cement (unnatural) and earth or stone (natural); 3) The condition of the walls of the house: woven (natural) and cemented (unnatural) materials; 4) House ventilation: with or without gauze filters; 5) The condition of the roof of the house: woven (natural) materials, light steel/tile (unnatural); 6) Closed and open/faulty house windows; 7) Location of the kitchen: inside and outside the house; 8) Location of bathrooms: inside and outside the house; 9) Existence of storage space for food ingredients (yes or no); 10) The existence of a door as a separator between rooms in the house (Yes and None).

Data Analysis

The data were analyzed through three stages. Firstly, univariate analysis was conducted to obtain an overview of the survey results on disease-transmitting mosquitoes and the physical environment of the houses. This analysis involved the distribution of frequency values and percentages/proportions. Secondly, bivariate and multivariate analyses were performed using simple logistic and multiple logistic regression tests with alpha (β) = 0.05. The results of the simple logistic regression analysis helped determine the relationship between the physical environmental conditions of the house and the presence of disease-transmitting mosquito vectors. Next, multiple logistic regression tests were conducted using the backward method to identify the determinant factors associated with the presence of disease-transmitting mosquitoes based on the results of the bivariate analysis with a p-value <0.25 (Ghozali, 2013). Additionally, the model's quality was assessed by calculating the Area Under the Curve (AUC) using the Receiver Operating Characteristic (ROC) method, while the model calibration was assessed using the Hosmer and Lemeshow test (Sopiyudin, 2017). This research was approved by the ethical commission of Respati Yogyakarta University with protocol number: 115.3/FIKES/PL/IV/2020 in April 2020.

RESULT AND DISCUSSION

Characteristics of Indigenous Peoples

Most of the respondents in Segenter Traditional Village are aged 30-44 years, female, do not have formal education, work as agricultural laborers, and are from the Sasak Tribe.

Characteristics of House Conditions

Settlements in Segenter Traditional Village have a regular layout of houses, types of houses, and spatial patterns of settlements, consisting of 105 households (391 people). The shape of the Segenter traditional settlement area looks quite dense because it has a clustered pattern and is surrounded by a fence with living plants. Three types of houses can be found in the Segenter Dusun Traditional Village, namely traditional houses (picture a1-a.4), mixed houses (picture b1-b2), and modern houses (picture c1-c2). These types of houses can be seen in Figure 1.

Description:

Figure 1 (a): Physical Construction Conditions of Traditional Houses: Traditional houses have simpler building construction compared to other houses (a1). They are made of natural materials found around

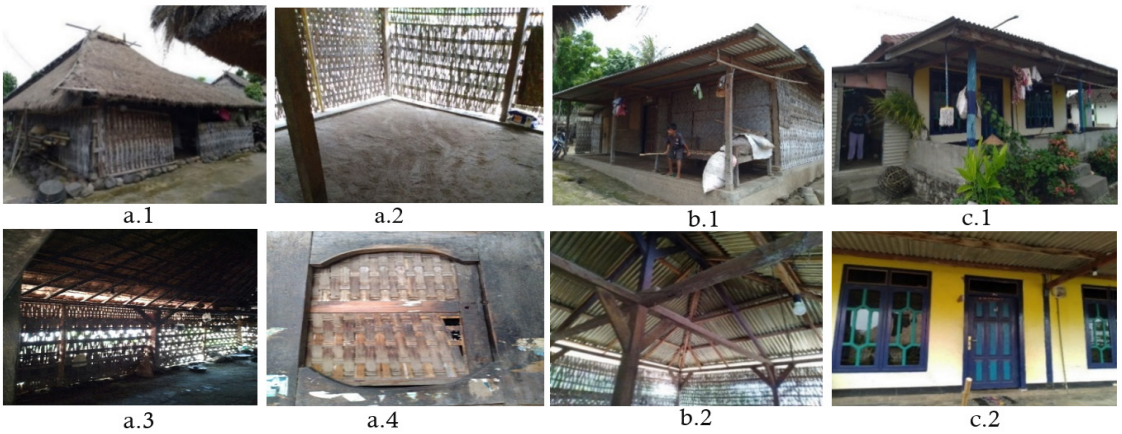

Figure 1. (a) Traditional Houses, (b) Mixed Houses, (c) Modern Houses

the village, such as bamboo, straw, and wood (a2). The walls made of woven bamboo serve the function of letting in and out light and air. The traditional house has a room without partitions, which functions as the kitchen with a stone fireplace, a bedroom, a storage room, an area for house hold equipment and farming (Amben Belek) (a3), and a Bale Inan, a small room for the newlyweds' bed or for storing rice (a4). All these functions are together within the house.

Figure 1 (b): Mixed house types are a combination of traditional and modern houses. The construction and form of mixed house buildings are quite simple, like traditional houses, but some parts of the house have changed, such as the roof with light steel/ tile and the floor of the house with cement /ceramic. There have been several changes in the use of natural materials into modern materials due to the limited materials available in nature, so some residents have switched to permanent house-building materials.

Figure 1 (c): A modern house is a type of house that has adapted to the changing times, and all the building materials used are modern (non-natural) materials. The walls of modern houses are made of bricks (permanent) and have windows and ventilation. The floors are tiled or made of cement. The rooms in the house have barriers between them (insulated between rooms), and light steel is used in the construction.

The shape, arrangement, and pattern of the house arrangement in Segenter Traditional Villages can be seen in Figure 2 below:

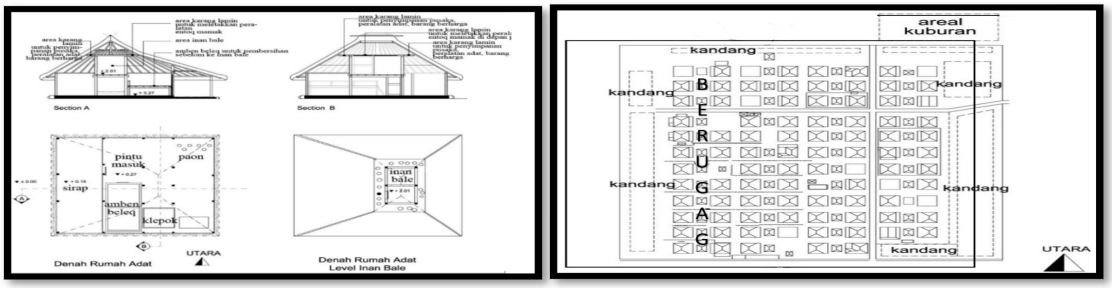

Figure 2. Plan and shape of the Segenter Traditional Villages (Made Wirata & Ngakan Putu Sueca, 2014)

Figure 2 explains that the arrangement of residential areas is built with a single door, with the houses in front facing each other and acting as separators. Berugak is used as a place to receive guests because, in traditional communities, it is not allowed to receive guests in the house. Another function is as a place for traditional rituals and also to carry out deliberations (Gundam). There are no physical boundaries between one building and another, such as a fence, because some homeowners still have family relationships and live close together on one piece of land. The distance between one house and another is approximately 3-5 meters.

Adult Mosquito Survey

Mosquitoes found in Segenter traditional village consist of four genera: (Culex sp., Aedes sp., Armigerres sp., and Verralina sp.), and 10 species. From the genus Culex, four types of species were obtained, namely Cx. quinquefasciatus, Cx. sitiens, Cx. fuscocephala, and Cx. Tritaeniorhynchus. Genus Aedes, 4 species of Ae. aegypti, Ae. albopictus, Ae. vexans, and Ae. vigilax, genus Armigeres, 1 species was found, namely Ar. Kesseli, and the genus Verralina sp.

Table 1 shows that the ten most common mosquito species were found in traditional type houses, followed by mixed house types with six species of mosquitoes, and the lowest number in modern houses with four species. These results indicate that traditional houses are preferred resting and egg-laying places for mosquitoes due to their physical characteristics.

Table 1. Types of mosquitoes found in each type of house in Segenter Traditional Villages

Mosquito Species	House Type		
	Traditional	Mixed	Modern
Cx. quinquefasciatus	+	+	+
Cx. sitiens	+	-	-
Cx. fuscocephala	+	-	-
Cx. tritaeniorhynchus	+	+	+
Ae. aegypti	+	+	+
Ae. albopictus	+	+	+
Ae. vexans	+	-	-
Ae. vigilax	+	-	-
Ar. kesseli	+	+	-
Verralina sp	+	+	-

This condition indicates that the construction of traditional houses is favored by many species of mosquitoes and provides access for mosquitoes to enter. Houses with open construction are the primary factor related to the high abundance of indoor mosquitoes (Howell & Chadee, 2007a). The mosquitoes were found resting on the walls of the house, the pillars of the house, the cloth covering the room, the walls, and the roof of the bale inan/special place for storing food, as well as the house where the bathroom and kitchen are located outside the house. Previous studies have shown that mosquitoes prefer houses with open roofs, thatched roofs, and unprotected windows.

Mixed houses (a combination of traditional and modern houses) have a fairly simple physical construction and form of houses, similar to those found in traditional houses. However, some parts of the house have changed, such as roofs made of corrugated iron and floors made of cement/ceramics. This change was made by family members due to the limited availability of natural materials, prompting residents to switch to modern house-building materials (Afrane et al., 2005). From the results of observations, it was also found that there was an open gap between the roof and the walls, which became a route for mosquitoes to enter the house. An open roof is reported to be the most important physical condition of the house in providing access for mosquitoes to enter (Kaindoa et al., 2018),(Ngadjeu et al., 2020).

A modern house is a house that has adapted to the changing times, using all modern (unnatural) building materials. The walls in modern homes are made of brick materials, and they have windows, ventilation, and tiled floors. The spaces in the house have barriers between rooms, and the roofs are made of corrugated iron or tiles. In a study conducted by Howell and Chadee, it was found that the amount of Cx. quinquefasciatus is larger in houses with cement materials than in slum houses (Howell & Chadee, 2007a). This study also found the same four species in the three types of houses in the Segenter Traditional Villages, namely Cx. quinquefasciatus, Cx. tritaeniorhynchus, Ae. aegypti, and Ae. albopictus, as these four species of mosquitoes have a habit of resting indoors. The species Ae. aegypti has anthropophilic and endophilic behavior, making it a vector for dengue fever, chikungunya, and Zika because it is close to humans (Morales-Pérez et al., 2017). Ae. albopictus has zoo-anthropophilic behavior and prefers to be near human settlements to find suitable breeding sites (Kraemer et al., 2015). Culex mosquitoes have endophagic and endophilic characteristics, meaning they search for food and rest inside the house (Tandina et al., 2018).

The presence of mosquitoes in the house is strongly related to the characteristics of the house and its location. The risk of being bitten by mosquitoes is lower in houses built with cement or mixed materials than in houses built with mud/board/straw. The results of this study are consistent with the study of Tusting et al. which suggests that increased protection can be achieved through home improvement (Tusting et al., 2015). Recent meta-analyses and systematic reviews provide evidence of the effectiveness of home screens on external doors and windows in preventing the transmission of dengue fever (Bowman et al., 2016), (Kua & Lee, 2021). Efforts to limit the entry of vectors into homes can reduce the number of mosquito bites that transmit disease and limit indoor transmission (Mponzi et al., 2022), (Wilson et al., 2020).

Home Environmental Factors Related to the Presence of Disease-Transmitting Mosquitoes

Observation results showing a correlation between home environmental factors and the presence of disease-transmitting mosquitoes can be seen in Table 2 below:

The results of the observations showed

Table 2. House Environmental Factors Related to the Presence of Disease-Transmitting Mosquitoes

Home Environmental	Presence of Mosquito Species				Point Estimates		Ratio Prevalence (CI 95%)	P-Value
	Exist		None		Risk (%)			
	n	%	n	%	Exposed	Un-Exposed		
House Type								
Modern* (Unexposed)	18	26,87	15	22,39				
Mixed (Risk Factor)	19	28,36	4	5,97	82,16	54,55	1,514 (1,053-2,178)	0,0329
Traditional (Risk Factor)	10	14,93	1	1,49	90,91	54,55	1,667 (1,159-2,397)	0,0321
House Floor								
Soil	31	46,27	10	14,93	75,61	61,54	1,229	0,2378
Cement/Ceramic	16	23,88	10	14,93			(0,866-1,744)	
House Wall								
Webbing	32	47,76	8	11,94	80,00	55,56	1,440	0,0391
Cemented	15	22,39	12	17,91			(0,993-2,087)	
Home Ventilation								
1. No Wire Netting								
2. There is Wire Netting	25	37,31	8	11,94	75,76	64,71	1,171	0,3401
	22	32,84	12	17,91			(0,855-1,603	
Kitchen Location								
Outside	33	49,25	4	5,97	89,19	46,67	1,911	0,0000
Inside	14	20,90	16	23,88			(1,283-2,847)	
Bathroom Location								
Outside	30	44,78	6	8,96	83,33	54,84	1,520	0,0135
Inside	17	25,37	14	20,90			(1,07-2,159)	
House Roof								
Webbing	29	43,28	6	8,96	82,86	56,25	1,473	0,0208
Light Steel/Tile	18	26,87	14	20,90			(1,048-2,071)	
Foodstuff Storage Room (Bale Inan)								
Exist	32	47,76	4	5,97	88,89	48,39	1,837	0,0000
None	15	22,39	16	23,88			(1,254-2,690)	
House Window								
Open	23	34,33	9	13,43	71,88	68,57	1,048	0,7772
Closed	24	35,82	11	16,42			(0,767-1,432)	
Door Presence								
No Separator/Cloth	31	46,27	4	5,97	88,57	50,00	1,771	0,0006
There is a Separator	16	23,88	16	23,88			(1,228-2,555)	
Total	47		20					

that the majority of disease-transmitting mosquitoes were found in traditional-type houses, with a proportion value of 90.91%, compared to 54.55% in modern-type houses. The statistical analysis indicated significant differences between the two types of houses (P-value < 0.05). These findings were further supported by the risk value measurement, which showed that traditional-type houses had a 1.667 times higher risk of being infested by disease-transmitting mosquitoes compared to modern-type houses. Similarly, mixed-type houses also had a higher proportion of disease-transmitting mosquitoes, with a value of 82.16%, compared to 54.55% in modern-type houses. The statistical analysis revealed a significant difference between the two types of houses (P-value < 0.05). The risk value measurement further indicated that mixed-type houses had a 1.514 times higher risk of being infested by disease-transmitting mosquitoes compared to modern-type houses.

The difference in the risk of disease-transmitting mosquitoes between traditional and mixed-type houses, compared to modern-type houses, can be influenced by the internal construction of the house. This relationship is evident in several variables, indicating a significant difference in the presence of disease-transmitting mosquitoes based on the physical construction of the house: 1) Houses with woven walls have a higher proportion of disease-transmitting mosquitoes, at 80%, compared to houses with cement walls, which have a proportion of 55.56%. Measuring the risk value reinforces these results, showing that houses with woven walls have a 1,440 times higher risk of being infected with disease-transmitting mosquitoes than houses with cement walls. 2) Kitchens located outside the house have a higher proportion of disease-transmitting mosquitoes, at 89.19%, compared to kitchens inside the house, which have a proportion of 46.67%. Measuring the risk value further supports these findings, indicating that kitchens located outside the home have a 1.911 times higher risk of being infected with disease-transmitting mosquitoes than kitchens inside the house. 3) Bathrooms located outside the house have a higher proportion of disease-transmitting mosquitoes, at 83.33%, compared to bathrooms inside the house, with a proportion of 54.84%. Measuring the risk value reinforces this observation, showing that bathrooms located outside the house have a 1.520 times higher risk of being infested with disease-transmitting mosquitoes than bathrooms inside the house. 4) Houses with woven roofs have a higher proportion of disease-transmitting mosquitoes, at 82.86%, compared to houses with light steel/tile roofs, with a proportion of 56.25%. Measuring the risk value further confirms these results, indicating that houses with woven roofs have a 1.473 times higher risk of being infected with disease-transmitting mosquitoes than houses with light steel/tile roofs. 5) Houses with a "Bale Inan" (food storage space) have a higher proportion of disease-transmitting mosquitoes, at 88.89%, compared to houses without "Bale Inan," with a proportion of 48.39%. Measuring the risk value supports this finding, showing that houses with "Bale Inan" have a 1.837 times higher risk of being infected with disease-transmitting mosquitoes than houses without "Bale Inan". 6) Houses without separate doors between rooms, or with only cloth as separation, have a higher proportion of disease-transmitting mosquitoes, at 88.57%, compared to houses with separate doors between rooms, with a proportion of 50%. Measuring the risk value reinforces this observation, indicating that houses without dividing doors between rooms have a 1.771 times higher risk of being infected with disease-transmitting mosquitoes than houses with separate doors.

The results of this study show that there is a relationship between the type of traditional house and the type of mixed house with the abundance of disease-transmitting mosquitoes. The indigenous people in Segenter Hamlet are the original inhabitants of the Muslim Sasak tribe, where each Customary Hamlet on Lombok Island has a pattern that is almost the same in terms of architecture and is influenced by belief in ancestors (Subiyantoro et al., 2019). The Sasak Traditional Village on Lombok Island consists of several traditional houses, berugak buildings, granary buildings (rice storage), livestock pens, and the surrounding environment. Local natural conditions influence the shape of the building and the use of building materials. In areas with a tropical climate, buildings with steep roofs are needed during the rainy season so that water can flow to the ground easily. The conditions of the humid tropical climate and the availability of building materials in the area around the Customary Hamlet area are the basis for consideration in building a house; this is an adaptation response to existing environmental conditions.The buildings in the Sasak Customary Hamlet of Lombok use natural materials that are easy to find in the surrounding area. The walls of the building use woven bamboo, which can provide good air circulation through the gaps in the woven bamboo. The roof of the building uses reed material, which can protect from the sun's heat and provi-

de warmth at night, and the higher floors of the house can provide warmth in the house (Sujarwo, 2019).

The description of traditional and mixed house construction makes these houses preferred by mosquitoes to rest and provides access for mosquitoes to enter the house (Rozendaal, 1997). Traditional houses also do not have partitions, so the kitchen, bedroom, and storage room become one in the house. This condition increases the risk for residents of the house to come into contact with mosquito vectors. This study is confirmed by the results of previous research, which stated that a house with a full filter is effective in reducing vector density in the room. So if the filter is only on the roof, then the integrated tropical disease control program will be neglected (Ogoma et al., 2010). The house is the main place of contact between humans and nocturnal biting mosquito vectors (Gamage-Mendis et al., 1991), (SNOW, 1987) so the physical construction of the house is one of the factors that influence the abundance of mosquitoes in a room (Baskoro et al., 2017), (Howell & Chadee, 2007b), (Vásquez-Trujillo et al., 2021). Traditional dwelling types built over 20 years are associated with the presence of mosquitoes (Sallam et al., 2017), (Castañeda et al., 2011). It is recorded that the results of studies in Vietnam and Indonesia also show that the frequency of Dengue Fever is related to the combination of several types of densely populated residential areas (Anders et al., 2015), (Harapan et al., 2019).

Determinant Factors Related to the Presence of Disease-Transmitting Mosquitoes

The results of data analysis show that the determinants of the home environment are related to the presence of disease-transmitting mosquitoes in Customary Hamlet, which can be seen in Table 3 below:

Table 3. Determinant Factors to the Presence of Disease-Transmitting Mosquitoes

Home Environmental `	β	**Sig.**	**Exp (β)**	**95% C.I.for Exp (β)**	
				Lower	**Upper**
Kitchen Location	2.415	0.000	2.340	1.427	3.980
Foodstuff Storage Room (bale inan)	1.307	0.002	2.140	1.266	3.122
Door Presence/Separator	1.209	0.005	2.138	1.132	2.876
Bathroom Location	1.203	0.006	1.912	1.121	3.832
House Roof	1.124	0.009	1.764	1.022	2.738
Traditional House Type	1.099	0.011	1.650	1.016	3.322
Mixed House Type	1.022	0.048	1.413	0.091	2.213
House Wall	0.871	0.067	0.113	0.632	1.165
Constant	-8.988	0.014	.086		

Note: Exp (β) = Exponent Beta; Sig.= Significance The results of the function quality assessment based on the Hosmer and Lemeshow Test calibration parameters show a score of 0.794, meaning that the function obtained has a proper calibration because P-Value> 0.05. The discriminant value based on the Area Under Curve (AUC) is 0.782 (78.2% = close to 100%). The variables found are categorized as strong so that they can be a suitable model for predicting the presence of disease-transmitting mosquitoes based on the physical conditions of Customary Hamlet Houses.

Table 3 shows that the determinant factor associated with the presence of disease-transmitting mosquitoes in houses in traditional villages is the location of the kitchen outside the house (Exp β = 2.340). This factor is reinforced by the presence of foodstuff storage room ("Bale Inan") (Exp β = 2.140), the absence of an insulating door in the house/only using cloth on the door (Exp β = 2.130), the location of the bathroom outside the house (Exp β = 1.912), the roof of the house made of woven (Exp β = 1.764), traditional house type (Exp β = 1.650), mixed house type (Exp β = 1.413), and wicker house walls (Exp β = 0.113).

This equation shows that the determinant factor that contributes 77.79% to the presence of disease-transmitting mosquitoes in traditional villages.

Equation (y) = -8.988+ 2.415 (Kitchen Location) +1.307 (Bale Inan) +1.209 (Door Presence/Separator) + 1.203 (Bathroom Location) +1.124 (House Roof) +1.099 (Traditional House Type) +1.022 (Mixed House Type) +0.871 (House Wall) = 1.262

$$Probability\ (P) = \frac{1}{(1+e^{-y})} = \frac{1}{(1+2{,}7^{-1{,}262})} = 0.778 \times 100 = 77.79\%$$

Notes:
P = Likelihood of occurrence of events/ Probability
e = natural number = 2.7
y = Constant = 1.262

Upon observation, the physical construction of traditional houses is quite open, making it easier for mosquitoes to enter the house. However, some indigenous people living in traditional, mixed, and modern houses still have the habit of cooking using firewood inside the house. Residents' cooking habits in the morning and evening also affect the temperature and humidity in the house, making it feel hotter during those times. Smoke can lower the humidity level in the house, making it feel hotter, and the presence of smoke can interfere with the chemoreceptors of mosquitoes (Biran et al., 2008). In a study conducted in Malawi, around 64% of housewives burned leaves, wood, or dung to produce smoke to drive away mosquitoes (Ziba et al., 1994). Smoke can affect mosquito-biting behavior because it is considered to cover human odors, especially carbon dioxide, which mosquitoes detect within a short distance of the host location (Rapaport, 2019).

Most of the people still maintain traditional basic materials due to ancestral traditions, as they cannot afford to buy modern building materials. However, despite the financial constraints faced by many in Customary Hamlet, there are cheaper and simpler ways to modify or screen houses that can effectively prevent mosquitoes from entering, especially if the community members are sensitive enough. This study recommends that local governments and agencies related to vector-borne disease control in Lombok Regency establish a House Screening (HS) program/Anti-Mosquito House. This program can help prevent human-mosquito contact and potentially reduce transmission of vector-borne diseases through home modifications without having to change people's belief in ancestral traditions.

HS is one of the oldest methods of mosquito control (Killeen et al., 2019), (Getawen et al., 2018). Evaluation results from previous studies through randomized controlled trials have shown that this program is effective for controlling vector-borne diseases if implemented continuously (Furnival-Adams et al., 2021). Studies on Anopheles mosquitoes also demonstrate that screened houses (screening on the roof and/or doors and windows) can reduce the prevalence of malaria by 60% compared to control houses without screening (Abong'o et al., 2022), (Ng'Ang'A et al., 2020). Other studies have also shown that female mosquitoes are dramatically reduced or even eliminated in homes with HS. Daily behavior practices may also contribute to the presence of mosquitoes indoors, for example, having a screened door that is opened every time someone enters or leaves the house, making it easier for mosquitoes to enter (Pablo Manrique-Saide et al., 2021), (Dzul-Manzanilla et al., 2018). A systematic review found that HS is the best evidence-based method that can effectively reduce DENV risk (Bowman et al., 2016), (Murray-Smith et al., 1996). Other research also confirms that HS provides protection against the risk of Dengue Fever (Che-Mendoza et al., 2018).

HS is an example of a housing intervention that follows the principle of "vector prevention through housing improvement and sustainable development" promoted by WHO (WHO, 2017a). However, most of these interventions have been neglected in vector-borne disease prevention and control policies and programs (WHO, 2017b). Only in 2017, WHO's special program through tropical disease research and training cited HS as a promising vector management approach for vector-borne disease prevention and control (Olliaro et al., 2018). Projects under the 'Eco-Bio-social Research' and 'Eco-health' programs in several countries through the International Development Research Center have shown that screening homes with insecticides mounted on aluminum frame mesh on doors and windows can be an effective barrier that provides ongoing protection against indoor Aedes aegypti infestation (Che-Mendoza et al.,2018), (Pablo Manrique-Saide et al.,2021), (Herrera-Bojórquez et al.,2020). In addition, ZIKV detection in Ae. aegypti during an outbreak can be reduced by 85% in houses with insecticides installed on doors and windows compared to the control group (Pablo Manrisque-Saide et al., 2021). The adoption of an HS program is highly dependent on its cost, scalability, and entomological/epidemiological impact. Therefore, in implementing the program, it is also necessary to change the behavior of the owner/occupant of the house with a community-based approach through improving and maintaining the condition of the house and the peri-domestic environment, carrying out

surveillance activities and implementing simple self-protection methods such as using mosquito nets when sleeping, using household insecticides, sprays, repellants, and others (Campbell et al., 2015).

CONCLUSION

The presence of disease-transmitting mosquitoes in Customary Hamlet was most commonly found in the location of the kitchen outside the house. This factor is reinforced by the presence of a foodstuff storage room ("Bale Inan") in the house, the absence of an insulating door in the house/only using cloth on the door, the location of the bathroom outside, the roof of the house made of woven, traditional house type, mixed house type, and wicker house walls. The determining factor contributes 77.79%. These findings contribute to the development of a reliable early warning system by controlling the determining factors associated with the spread of diseases transmitted by mosquito vectors, through promotion, prevention, and control programs at the community and individual levels. The Screening (HS)/Anti-Mosquito Program is one of the programs that is expected to help prevent human-mosquito contact in the house through a local cultural approach to realize healthy tourism in Indonesia.

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AUTHOR CONTRIBUTIONS

All Authors conceived of the presented idea in this manuscript. T.B.T: developed the theory, N.A.P: Analyzed data and co-wrote the manuscript, P.G., L.A.R: Verified the analytical methods, P.G: Ensure the observation procedure of research variables, N.A.P: verify the data. All authors discussed the results and contributed to the final manuscript: N.A.P, T.B.T.S: wrote the manuscript with support from P.G., L.A.R.

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