

ORIGINAL ARTICLE

CASE STUDY OF HOST AND ENVIRONMENT FACTORS ON DHF INCIDENCE IN LIMA PULUH DISTRICT

Studi Kasus Faktor Host dan Lingkungan Terhadap Kejadian DBD di Kecamatan Lima Puluh

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ABSTRACT

Background: In the last fifty years, dengue hemorrhagic fever (DHF) has increased 30 times in 100 endemic countries. As a tropical country, Indonesia is one of the endemic countries for DHF cases, which often cause "extraordinary events". **Purpose:** This research aims to analyze the factors contributing to DHF, including individual and environmental factors. **Methods:** In November 2022, the unmatched case-control research method was retrospectively used. All DHF cases in Lima Puluh District between January and August 2022, totalling 26 cases, made up the population of this study. The sample in this study was taken based on the total sampling method. The sample consisted of 26 respondents in the case group (those affected by DHF) and 52 respondents in the control group with inclusion criteria (not affected by DHF, distance from house \pm 50 meters, age criteria, sex according to the case group) and exclusion criteria (not willing to be a respondent, not in place). The total sample size is 78 respondents, consisting of 26 respondents in the case group and 52 respondents in the control group, with a ratio of 1:2. **Results:** Based on the results of the chi-square analysis conducted. There was no significant relationship between gender ($p = 0.09$) and the habit of hanging clothes ($p = 0.06$) with the occurrence of DHF in Lima Puluh District in 2022. The results of the logistic regression test stated that all host and environmental factors did not have the most dominant variable in the incidence of DHF in Lima Puluh District in 2022. **Conclusion:** The variable of the existence of

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breeding places is a dominant factor in the occurrence of DHF in Lima Puluh District in 2022.

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ABSTRAK

Background: Dalam lima puluh tahun terakhir, angka kejadian DBD meningkat sebanyak 30 kali lipat yang terdapat di 100 negara endemis. Sebagai negara tropis, Indonesia merupakan salah satu negara endemis kasus penyakit DBD yang sering menimbulkan Kejadian Luar Biasa. **Purpose:** Penelitian ini bertujuan untuk menganalisis faktor-faktor penyebab DBD yang meliputi faktor host dan lingkungan. **Methods:** Pada November 2022, metode penelitian Unmatched Case Control secara retrospektif digunakan. Seluruh kasus DBD di Kecamatan Lima Puluh selama bulan Januari dan Agustus 2022 yang berjumlah 26 kasus merupakan populasi penelitian ini. Sampel dalam penelitian ini diambil berdasarkan metode total sampling. Sampel terdiri dari 26 responden pada kelompok kasus (yang terkena DBD) dan 52 responden pada kelompok kontrol dengan kriteria inklusi (tidak terkena DBD, jarak rumah \pm 50 meter, kriteria umur, jenis kelamin sesuai kelompok kasus) dan kriteria eksklusi (tidak bersedia menjadi responden, tidak ada ditempat). Total sampel 76, terdiri dari 26 kelompok kasus dan 52 kelompok kontrol, dengan perbandingan rasio 1:2. **Results:** Berdasarkan hasil analisis chi-square yang dilakukan, tidak terdapat hubungan yang bermakna antara jenis kelamin ($p=0,09$) dan kebiasaan menggantung pakaian ($p=0,06$) dengan kejadian DBD di Kecamatan Lima Puluh tahun 2022. Hasil uji regresi logistic menyebutkan bahwa seluruh faktor host dan lingkungan tidak terdapat variable yang paling dominan dengan kejadian DBD di Kecamatan Lima Puluh tahun 2022. **Conclusion:** Variabel keberadaan breeding places merupakan factor yang paling di Kabupaten Lima Puluh tahun 2022.

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INTRODUCTION

Disease prevention and control are two efforts to achieve a healthy and prosperous life following one of the Sustainable Development Goals (SDGs). Murwanto et al (1) say that the rising morbidity and mortality rates brought on by infectious diseases are an impediment to achieving this goal. As a tropical nation, Indonesia is home to several zoonotic illnesses that frequently result in “extraordinary events”, such as dengue hemorrhagic fever (DHF) (2).

In 100 endemic nations during the past 50 years, the prevalence of DHF has grown 30-fold, with an estimated 50–100 million infections happening each year (3). The high rate of dengue infection worldwide caused as many as 22,000 deaths in 2019 (4). WHO mentions Asian countries as having the highest number of DHF sufferers, with Indonesia having the highest cases in Southeast Asia (5). Since the first DHF cases were found in Indonesia, precisely in Surabaya, in

1968, the number of cases has fluctuated yearly (6). The prevalence of DHF in Indonesia increased significantly between 2018 and 2019, but it is expected to fall by 68,614 cases and 664 fatalities by 2021. As of February 2022, 13,776 dengue cases and 145 deaths have been reported.

The host (human behaviour), the vector (*Aedes aegypti* and *Aedes albopictus*), and the environment are generally the three elements contributing to the spread of dengue cases. Research conducted by Sinaga and Hartono (7) in Medan Johor also stated that eradicating mosquito nests through Drain, Cover and Burry (DCB) and hanging clothes had a significant relationship with the incidence of DHF. The emergence of DHF cases comes from factors of cleanliness in the residence, such as the cleanliness of the tub in the bathroom, damaged drains, and household waste that does not get enough attention from the owner of the residence, which results in the emergence of mosquito larvae in damp places (8). The *Ae. aegypti* mosquito can more readily create a chain

of transmission in the densely populated housing because it tends to be thick and humid.

Numerous mosquito larvae appear due to poor environmental sanitation. According to research by Kurniawati et al (9), every host who resides in a home with mosquito larvae has a 1.4 times greater probability of contracting DHF. According to Muda and Haqi (10), poor environmental sanitation behaviour, such as abundant water storage containers in moist or shaded areas adjacent to residences, impacts the high incidence of DHF. Research conducted by Anggraeni et al (11) in Tangerang stated that the presence of breeding sites (p-value 0.00) and resting areas (p-value 0.06) has an increased risk of dengue outbreaks.

Monitoring the initial survey results revealed that DHF incidence tends to be steady and endemic from year to year in the research destination region. The main factors that cause DHF are known based on host and environmental factors. As a result, this study aims to examine how host and environmental variables impact the prevalence of DHF in the Lima Puluh Batu Bara region. To prevent DHF in the future, it may be useful to understand the factors that contribute most to its occurrence.

METHODS

This study used an analytic survey with an Unmatched Case Control research design, which emphasizes the time of measurement of independent variable data (host and environment) with the dependent variable (dengue hemorrhagic fever) not being carried out simultaneously or retrospectively. The research was conducted in Lima Puluh District, Batu Bara Regency, in November 2022.

According to information from the Batu Bara Health Office, DHF patients in the Lima Puluh district between January and August 2022 were distributed across three villages or wards: Lima Puluh Kota, Perkebunan Tanah Gambus, and Perkebunan Lima Puluh. Therefore, the population in this study consisted of all 26 cases of dengue hemorrhagic fever (DHF) among Lima Puluh District residents between January and August of 2022. The sample in this study was taken based on the total sampling method. The sample consisted of 26 respondents in the case group (those affected by DHF) and 52 respondents in the control group with inclusion criteria (not affected by DHF, distance from house \pm 50 meters, age criteria, sex

according to the case group) and exclusion criteria (not willing to be a respondent, not in place) with a ratio of 1:2. Provisions that apply include inclusion and exclusion criteria to filter respondents according to what researchers want.

The primary data collection process was based on the results of interviews with respondents conducted by conducting research instruments, distributing questionnaires that were distributed directly, and making observations. Data on the case group was obtained through the Batu Bara District Health Office and the Lima Puluh Health Center. The data obtained is then processed using SPSS to see the relationship between the independent and dependent variables.

The independent variables in this study consisted of host factors (age, sex, habit of hanging clothes, habit of using mosquito repellents and doing 3M PLUS such as draining, closing, utilizing, and preventing mosquito breeding as a plus effort) and environmental factors (water reservoirs, existence of breeding places, occupancy density, presence of ornamental plants, and installation of wire netting). With the issuance of ethical certificate number 004/KEPK/UNPRI/IX/2022 on September 6, 2022, the Health Research Ethics Commission (KEPK) of Prima Indonesia University determined that this research was ethically permissible aims to analyze the factors contributing to DHF, including individual and environmental factors.

RESULTS

The results showed that 11 respondents (14.10%) were found to work as students in the case group, and 18 respondents (23.12%) were found to work as housewives in the control group. Most of the respondents in the case group were at the elementary school level, namely 14 respondents (17.92%), while in the control group, the majority were at the senior high school level, with 22 respondents (28.22%) (Table 1).

The results in Table 2 show that the age variable in some of the case groups was young (24.40%) with a p-value of $0.00 < 0.05$ with an OR value (odds ratio) of 8.42 (95% CI = 4.20-16.89). This means there is a relationship between age and the incidence of DHF. Young respondents had 8.42 times the risk of experiencing DHF compared to respondents who were adults. Most respondents were of both sexes in the case and control groups. The p-value of $0.09 > 0.05$ with an OR value (odds ratio) of 2.73 (95% CI = 0.98-7.60) means that

gender is not related to the incidence of DHF. However, men are 2.73 times more at risk of experiencing DHF than women.

The habit of hanging clothes in the case group was mostly not good (23.10%) with a p-value of $0.06 > 0.05$ and an OR value (odds ratio) of 2.83 (95% CI = 1.04–7.68), which means that the habit of hanging clothing has no relationship with the incidence of DHF. However, respondents with a not-good habit of hanging clothes have 2.83 times the risk of getting DHF compared to respondents

with a good habit of hanging clothes. Then, the habit of using mosquito repellent was not carried out by the case group (29.51%). The acquisition of a p-value of $0.00 < 0.05$ with an OR value (odds ratio) of 23.00 (95% CI = 5.92–89.34) means that respondents who do not use mosquito repellent have 23 times the risk of experiencing DHF compared to respondents who use mosquito repellent.

Table 1
Distribution of Respondent Characteristics

Variable	Incidence of DHF				Total	
	Case		Control		n	%
	n	%	n	%		
Work						
Civil Servant	0	0.00	6	7.72	6	7.71
Trader	2	2.61	9	11.52	11	14.10
Farmer	0	0.00	6	7.71	6	7.71
Private Employees	0	0.00	1	1.32	1	1.31
Laborer	2	2.62	9	11.51	11	14.11
Student	11	14.10	0	0.00	11	14.10
Not Work	8	10.33	3	3.82	11	14.10
Housewife	3	3.84	18	23.12	21	26.90
Education						
No School	8	10.30	0	0.00	8	10.30
Elementary School	14	17.92	8	10.30	22	28.21
Junior High School	1	1.31	14	17.91	15	19.21
Senior High School	3	3.81	22	28.22	25	32.10
DIII/Bachelor Degree	0	0.00	8	10.32	8	10.30
Total	26	33.33	52	66.67	78	100.00

A total of (23.14%) of the case group did not perform 3M Plus well. So, a p-value of $0.00 < 0.05$ with an OR value (Odds Ratio) of 17.25 (95% CI = 5.24–56.73), which means that doing 3M Plus has a relationship with the incidence of DHF. This also refers to respondents who do 3M Plus badly, who have a 17-time risk of getting DHF compared to respondents who do 3M Plus well. Furthermore, each respondent already has a good water reservoir. The p-value of $0.00 < 0.05$ with an OR value (odds ratio) of 3.73 (95% CI = 2.54–5.49) means that water storage places have a relationship with the incidence of DHF. With the OR value obtained, respondents with water reservoirs where larvae are present have a 3.73 times higher risk of experiencing DHF than those with larva-free water reservoirs.

The existence of breeding places was found in many cases (21.82%) with a p-value of $0.00 < 0.05$ with an OR value (odds ratio) of 22.66 (95% CI =

6.17–83.27), which means that there is a relationship between the existence of breeding places with the incidence of DHF so that respondents who have breeding places have a 22-fold increased risk of getting DHF compared to respondents who do not have breeding places. Residential density at proximity was found in the case group (30.82%) with a p-value of $0.00 < 0.05$ with an OR value (odds ratio) of 9.51 (95% CI = 2.03–44.51), which means that there is a relationship between occupancy density and the incidence of DHF. Respondents with close residential density have a 9.51-fold higher risk of getting DHF than those with far residential density.

On average, the existence of ornamental plants was not owned by the case or control group. So a p-value of $0.00 < 0.05$ is obtained with an OR value (odds ratio) of 5.87 (95% CI = 1.74–19.78), which means that ownership of ornamental plants

is related to the incidence of DHF, and respondents who have ornamental plants have a 5.87 times higher risk of getting DHF compared to respondents who do not have ornamental plants. Installing wire netting is considered bad (16.70%), with a p-value of 0.01 <0.05 with an OR value

(odds ratio) of 3.72 (95% CI = 1.34–10.30). This means that the installation of wire netting is related to the incidence of DHF. So, respondents with bad screens had a 3.72-fold higher risk of getting DHF than those with good screens.

Table 2

Relationship between Host and Environmental Factors with DHF Incidence in Lima Puluh District Batu Bara Regency in 2022

Variable	Incidence of DHF				Total		P-Value	OR CI	95%
	Case		Control		n	%			
	n	%	n	%					
Age									
Young (11-19)	19	24.40	0	0	19	24.40	0.00	8.42	(4.20-6.89)
Adult (20-60)	7	9.00	52	66.70	59	75.60			
Gender									
Men	11	14.10	11	14.10	22	28.20	0.09	2.73	(0.98-7.60)
Women	15	19.20	41	37.30	56	71.80			
Habit of Hangging Clothes									
Not Good	18	23.10	23	29.50	41	52.60	0.06	2.83	(1.04-7.68)
Good	8	10.30	29	37.20	37	47.70			
Habit of Using Mosquito Repellent									
No	23	29.50	13	16.70	36	46.20	0.00	23.0	(5.92-89.34)
Yes	3	3.80	39	50.00	42	53.81			
Do 3M Plus									
Bad	18	23.10	6	7.70	24	30.80	0.00	17.25	(5.24-56.73)
Well	8	10.30	46	59.00	54	69.20			
Water Reservoirs									
Yes	7	9.00	0	0.00	7	9.00	0.00	3.73	(2.54-5.49)
No	19	24.40	52	66.70	71	91.00			
Existence of Breeding Place									
Yes	17	21.8	4	5.10	21	26.90	0.00	22.66	(6.17-83.27)
No	9	11.50	48	61.50	57	73.10			
Occupancy Density									
Near	24	30.80	29	37.20	53	67.90	0.00	9.51	(2.03-44.51)
Far	2	2.60	23	29.50	25	32.10			
Existence of Ornamental Plants									
Yes	10	12.80	5	6.40	15	19.20	0.00	5.87	(1.74-19.78)
No	16	20.50	47	60.30	63	80.80			
Installation of Wire netting									
Bad	13	16.70	11	14.10	24	30.80	0.01	3.72	(1.34-10.30)
Well	13	16.70	41	52.60	54	69.20			
Total	26	33.33	52	66.77	78	100			

DISCUSSION

The previous research by Andriawan et al (12), which produced the same findings, showed a significant correlation between age and the incidence of DHF and explained why young people are more susceptible to DHF because they have a weak immune system and are involved more in activities at outdoors, such as school and play. Sholihah et al (13) stated that many DHF control programs only aim to reduce or eliminate mosquitoes around the house. However, young people still have a significant risk of contracting DHF outside the home.

Dengue fever is something that can happen to all humans. However, age greatly influences the incidence of DHF, considering that the number of cases is fixed or even increasing. In any epidemiological investigation, age is a factor to be considered. Age is always used as an indicator in disease epidemiology. Therefore, every disease that involves morbidity or death always shows an age association.

Gender is a self-identity obtained biologically from birth and distinguished by its genitals. In this study, most groups that did not experience DHF were women, with as many as 41 respondents (37.32%). A stronger immune response makes women more likely to be at risk of experiencing DHF than men (14). Based on Idris and Zulaikha's research (15), it has been determined that there is no correlation between gender and the incidence of DHF and that gender is only a predisposing factor or a factor that influences how a person behaves or acts according to their respective gender. This opinion is reinforced by a literature review conducted by Tansil et al (16), which found that although gender is not a direct cause of DHF, it may be related if associated with work.

The habit of hanging clothes in the room or bathroom risks becoming a breeding ground for *Ae. aegypti* mosquitoes, especially on damp clothes that smell of sweat. Hanging clothes for more than two days makes more mosquitoes rest on hung clothes. Samingan and Ramadhanty (17) stated that even though hanging clothes has no relationship, such bad behaviour will lead to many *Ae. aegypti* mosquitoes in the house will increase the risk of dengue fever, especially in endemic areas. The need for public awareness to get used to "clean and healthy behavior" must be strengthened. Mahendra et al (18) concluded that losing hanging clothes can be a first step in preventing DHF in the home environment. Health

promotion regarding DHF will have an impact if it is accompanied by real community behaviour.

The results of this study are in line with the research of Kastari and Prasetyo (19), which states that the habit of using mosquito repellents has a relationship with the incidence of DHF, where people who do not use mosquito repellents in the morning and at night will be at greater risk of getting DHF compared to people who do not. Routinely use mosquito repellent or anti-mosquito spray in the morning and at night. The drugs and anti-mosquitoes referred to in this study are fuel, spray, topical and electric. The use of mosquito coils in this study was still lacking, especially for respondents who had used mosquito nets while sleeping. Even though, in reality, mosquito nets will only protect themselves from mosquito bites while sleeping, they do not protect themselves when outside the room, especially in the morning (8 am – 1 pm) and at night (3 pm – 5 pm). Because, on average, people sleep after 8 pm and under bedtime, they will still be at risk of being bitten by *Ae. aegypti* mosquitoes if they do not have outside protection such as medicine or anti-mosquito spray. The use of this type of topical mosquito repellent is more recommended because it is practical, can be taken anywhere, and can be used both in the morning and at night outside and inside the house. This type of topical mosquito repellent is recommended because it is practical, can be taken anywhere, and can be used both in the morning and at night outside and inside the house. Herbal medicines or anti-mosquitoes, such as mosquito repellent from lemongrass leaves, according to the research of Zulfikar et al (20), and administering liquid electricity from essential oil, according to the research of Pangestu et al (21), can be used.

The increase in the incidence of DHF has a close relationship with host behaviour factors in carrying out the Elimination of Mosquito Nests (EMN) or those familiar with 3M Plus. The same thing was found in a literature review by Periatama et al (22), with the result that there was a relationship between DHF incidents and 3M Plus behaviour due to a lack of public awareness in draining, covering, burying, and other steps in eradicating mosquito breeding. The existence of larvae-eating fish is one of the plus activities in 3M Plus behaviour. However, only six respondents (7.72%) kept larvae-eating fish.

People only do 3M Plus activities, such as draining tubs and using mosquito nets. The community's knowledge of eradicating mosquito

nests still needs to be improved, so they tend never to carry out one of the 3M Plus activities properly. The tendency of people to only know about fogging and larvicidal slurry for eradicating mosquitoes has made eliminating mosquito nests by the 3M Plus program ineffective.

The water reservoirs referred to in this study are used in daily activities such as cooking, bathing, and washing. At the time of the study, the researchers found that some respondents used a permanent bathtub without a cover and dark in colour. This condition of the water storage area indicates the presence of mosquito larvae because the water is repeatedly filled and rarely drained, resulting in many mosquito larvae in the water reservoir. One of the conditions for a good water reservoir is that it is closed. This opinion is supported by research by Octaviani et al (23), showing that open-water reservoirs have a 2.71 times higher chance of becoming mosquito breeding grounds than closed-water reservoirs. Water reservoirs, such as white jerry cans, are more sterile than mosquito larvae because the water is only released when needed. To avoid breeding *Aedes aegypti* mosquitos, the type of water reservoir used must be chosen with public input.

The same thing was found in the research of Marbun et al (24), with the results ($p = 0.00$) conducted in Serdang Bedagai showing that the existence of breeding places is related to the incidence of DHF, so that the risk of DHF incidents will continue to increase if more breeding places are found on the home page.

In this variable, it was found that there were breeding places in several places, such as coconut shells, water drums, paint cans, used tires, and trash cans, where mosquito larvae were found. The number of breeding sites in the home yard was fine for the respondents because the existing breeding places were used for daily needs such as watering flowers, burning trash, and trash cans. However, the presence of mosquito larvae was not noticed in the breeding places, which are breeding grounds for *Ae. aegypti* mosquitoes.

Used items around the house should be removed, or if they are still being used in the future, store them in a closed place so as not to collect water and serve as a breeding ground for mosquitoes. Based on the results of the research questionnaire, respondents prefer to sell used goods in their yard. However, few respondents still let it pile up in the yard, and only 6.64% of

respondents have warehouses for storing used goods.

Residential density in this study is the distance between the respondent's house and the neighbours. The flying distance of the *Ae. aegypti* mosquito from the source of the disease is less than 100 meters, so the existence of housing types in national housing, clusters, and urban areas puts people at significant risk of contracting DHF. The demographic location of the respondent's housing is mostly in densely populated urban areas. So many of the case group respondents experienced DHF and spread it to other family members and even the closest neighbours.

The study results are the same as those of Sutriyawan et al (25), who say that occupancy density is related to the incidence of DHF. This is due to the close and specific distance of the house from *Ae. Aegypti* mosquitoes bite many people quickly, so the transmission of DHF will occur. More comprehensive in a narrow scope. The spread of DHF has a clustered pattern, especially in urban areas with high population density.

This can be overcome by taking preventive measures such as always ensuring the house is in standard lighting, humidity, and temperature. Nolia and Kalto (26) stated that protecting the environment around the house is necessary to ensure that there are few water reservoirs as mosquito breeding sites because the denser the occupancy, the more breeding places there are.

The presence of ornamental plants is used by *Ae. aegypti* mosquitoes as a resting place after sucking human blood. Trends in ornamental plants, both original and imitation, decorate the yard so that the whole house is decorated with ornamental plants. The character of ornamental plants that are cool and dark makes them a place for blood absorption for the development of eggs until they are finished. Yati et al (27), stated that ornamental plant pots with water media can be used as a mosquito breeding medium.

The existence of lush ornamental plants can block sunlight from entering the house; as a result, the house will become damp, and mosquitoes like places like that. Ownership of ornamental plants is not something that is prohibited, but it is the process of caring for them and their location that must be considered.

Installing wire netting on house ventilation needs to be done so that there are no opportunities for mosquitoes to enter through the ventilation. The screen installation is said to be harmful if the screen used is damaged and is more than five years

old, and it is not uncommon for many respondents to have no screen at all for house ventilation. The lack of public interest in installing screens is due to the high costs that must be incurred and the need for more public knowledge about the benefits of installing screens for dengue prevention. Wire netting can prevent mosquitoes from entering and preventing dengue (28). This research is in line with Fadrina et al (29) in a DHF-endemic area, namely Langkat Regency, which shows that there is a relationship between the installation of wire netting and the incidence of DHF. During the observation process, researchers found 13 respondents (16.71%) in the case group where the wire installation was classified as bad.

Wherever the wire netting is installed, it will be necessary for the family's health in the house. Installation of wire netting is critical in every home; in addition to preventing the entry of DHF mosquitoes, it can also prevent the entry of mosquitoes that can cause malaria and filariasis.

Research Limitations

The researcher conducted a retrospective study using disease data from the Batu Bara Health Office from January to August 2022. However, it did not include cases of DHF spread as a sample from September to December. The explicit analysis was not done in the laboratory analysis results. Apart from fogging, research on risk factors for DHF during January-December 2022 by exploring the homes of DHF sufferers can be used as a recommendation for future research.

CONCLUSION

This study has provided the results of analysing host and environmental factors associated with the incidence of DHF in the District of Lima Puluh. Factors such as age, the habit of using mosquito repellents, doing 3M Plus, water reservoirs, the existence of breeding places, residential density, the presence of ornamental plants, and the installation of wire netting have a relationship with the incidence of DHF in Lima Puluh District, Batu Bara Regency, in 2022. Furthermore, it found that gender and the habit of hanging clothes were unrelated to DHF Lima Puluh District, Batu Bara Regency's incidence in 2022. The community must participate in DHF prevention and control programs and collaborate with the Batu Bara Health Office.

CONFLICT OF INTEREST

The authors hereby state that there is no conflict of interest in this research.

AUTHOR CONTRIBUTIONS

All authors acknowledge that we actively participated in the research and writing of this article and share responsibility for the content, including the preparation and drafting, design, analysis, or revision of the article. TG: conceptualization, methodology, review writing, and editing. PYP: Oversight and Funding ELEP: Data Curation and Validation D and SI: Investigation Software, Original Drafting, and Visualization.

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