



RESEARCH ARTICLE

REVISED Attitude towards dengue control efforts with the potential of digital technology during COVID-19: partial least squares-structural equation modeling [version 2; peer review: 2 approved]

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Abstract

Background: Dengue fever is still a public health issue in Indonesia, and during the coronavirus disease 2019 (COVID-19) pandemic, integrated digital technology will be required for its control. This study aims to identify critical indicators influencing attitudes towards dengue control related to the potential for implementing digital technology.







Methods: This was a cross-sectional survey, with 515 people willing to fill out an online questionnaire. The analysis was conducted using Partial Least Square-Structural Equation Modelling (PLS-SEM). There were 46 indicators used to assess attitudes toward dengue control, which were organized into six variables: the need for digital information systems, perceptions of being threatened with dengue, the benefits of dengue control programs, program constraints, environmental factors and attitudes in dengue control.


Results: The source of information needed for dengue control was mainly through social media. There was a positive relationship between perception of environmental factors to perception of dengue threat, perception of program constraints, perception of program benefits, and perception of digital technology needs. Perception of program benefits and threatened perception of dengue have a positive relationship with perception of digital technology needs.


Conclusions: This model showed the variables perception of digital technology and perception of benefits had a positive association with attitude towards dengue control

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

attitude, dengue, potential, technology, modelling dengue transmission



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REVISED Amendments from Version 1

This paper receives inputs from the reviewers to make this manuscript easy for readers to understand. State of the art of this research has been emphasized by conveying the problem gaps based on studies that have been conducted in the past. Theoretical reviews are also added, as well as hypotheses, so that the readers can follow the researcher's view of thought based on existing theories. The method section is strengthened by theory as the basis for selecting the variables studied. Research implications for the field have also been added. All inputs are to make this paper more comprehensive and easy for readers to understand.

Any further responses from the reviewers can be found at the end of the article

Introduction

Dengue haemorrhagic fever (DHF) is still a global public health problem in tropical and subtropical climates. This mosquito-borne disease has spread rapidly in the last 50 years, and WHO estimates that the annual cases reach 50–100 million DHF infections.¹ Furthermore, the cases have tripled to 390 million, with more than 70% of the world's population at risk.²

The global spread of dengue fever is influenced by urbanization, globalization, and less effective vector control. The level of dense human population in an area is also followed by the density level of the *Aedes aegypti* mosquito.^{3–5} The haemorrhagic fever can be transmitted through mosquito bites from one human to another. In addition, the development of the aviation industry in various countries increases the mobility of humans and vectors from one country to another. The lack of practical control efforts has led to dengue disease outbreaks in various regions.⁶

More than 70% of the population at risk of DHF live in the Southeast Asia and West Pacific region, with a global disease burden of 75%. Therefore, WHO promotes making strategic plans to quickly detect and control disease outbreaks and stop their spread to new areas.⁷ Sustainable vector control methods, public health policymakers, and vaccine development should receive serious attention in controlling the current and future global distribution of DHF.⁸

Indonesia is one of the countries endemic to dengue fever. The first DHF case was reported in 1968 in Surabaya, and since then, the incidence rate has increased from 0.05 to 35–40 per 100,000 population and peaked in 2010 (IR 85).⁹ Based on the Ministry of Health report, until July 2020, there were 73,329 cases and 467 deaths. The regencies with the highest incidence rates in 2020 are Buleleng, Bali (2677 cases), Badung, Bali (2,138 cases), Bandung City (1,748 cases), East Jakarta (1,765 cases), and Sikka (1,715).¹⁰

During the current coronavirus disease 2019 (COVID-19) pandemic, efforts to control DHF cannot be carried out optimally because of health protocols. These include social distancing, wearing masks, and being careful about receiving foreign guests. This makes it challenging to collect data door to door, and the condition requires a digital technology approach to conduct surveillance and health education in the community. An integrated dengue surveillance and control system is needed in the endemic areas. Data collection should be quick and easy, as well as educate the public on vector control. Therefore, it is necessary to study the potential development of digital technology in dengue control during the COVID-19 pandemic.

There are several studies in Indonesia regarding attitudes toward dengue control. A study in Kupang, Indonesia, explains that a significant relationship exists between knowledge, attitudes, and actions in controlling dengue.¹¹ Likewise, other studies in Indonesia show that knowledge and attitudes influence dengue prevention measures.^{12,13} Another study in Indonesia on community perspectives on electronic-based dengue vector surveillance during the COVID-19 pandemic.¹⁴ There are also studies on developing a mobile-based dengue surveillance information system as an early warning system.^{15,16}

Digital technology has developed rapidly in the health sector. Digital technology is beneficial during the Covid-19 pandemic for conducting dengue surveillance. The existence of a social restriction policy with social distancing has caused the door-to-door control program not to be implemented.^{17–19}

Attitudes in dengue control are essential because they can influence control measures. This model is needed in analyzing variables related to attitudes and the use of digital applications in conducting dengue surveillance. This study will obtain a potential model that can be used as a digital innovation for dengue control. This study aimed to identify critical indicators influencing attitudes towards DHF control related to the potential for implementing digital technology.

Literature review

The co-epidemic trend of COVID-19 and dengue in Southeast Asia needs serious attention. These two diseases have similar clinical symptoms.^{20,21} The COVID-19 pandemic situation is a challenge in controlling dengue in Indonesia. The existence of a social restriction policy makes it difficult for volunteers to provide education manually door to door. The impact is increased dengue cases in several areas.²²

Public awareness regarding dengue control efforts still needs to be improved. Knowledge related to dengue can influence attitudes toward dengue control.^{23,24} A positive attitude can encourage action to control dengue.^{25,26} A large number of water containers is a breeding ground for mosquitoes. This is a potential mosquito breeding site that needs to be controlled. Several studies also state that interventions are needed to increase knowledge, attitudes, and actions in controlling dengue.²⁷⁻²⁹ Perceptions of the threat to the disease and the benefits of the interventions also influence attitudes towards dengue control. This is in accordance with the concept of the health belief model.³⁰

Attitudes towards dengue control using digital technology need to be studied for the driving and inhibiting factors. Intervention with digital technology requires supporting facilities and infrastructure.^{18,17} Digital educational media that can increase public knowledge is needed during the COVID-19 pandemic. Through socialization with digital educational media, prevention activities can be carried out widely despite a social distancing policy.

The development of digital technology has helped health services to provide fast and integrated services. Particularly in dengue control, digital interventions can help conduct surveillance of areas with mosquito density, larval density, and several dengue cases so that they can make a priority scale.^{31,32} Utilization of digital technology in conducting digital data collection and education can provide early detection and response to dengue cases in an area.

Methods

Conceptual model and hypotheses

The theoretical model adopts a health belief model between perceptions and dengue control behaviour.³³⁻³⁵ The health belief theory is then modified by adding environmental variables and the need for digital technology. The hypotheses were compared with six latent constructs related to dengue control attitudes, influenced by perceptions of the threat of dengue, program benefits, environmental factors, program constraints, and technology needs (Figure 1).³⁶ The direction of the path shows the (+) and (-) effects of the relationship, and this study assessed the accuracy of the model and hypothesis with PLS-SEM.

Regarding potential bias in this study, online data collection means that respondents can answer questions repeatedly. Thus, to reduce bias, data validation was carried out based on names and addresses. Incomplete answers, this is done with a re-checking system and requires answering. Respondents also only represented the Denpasar City area, not representing Indonesia.

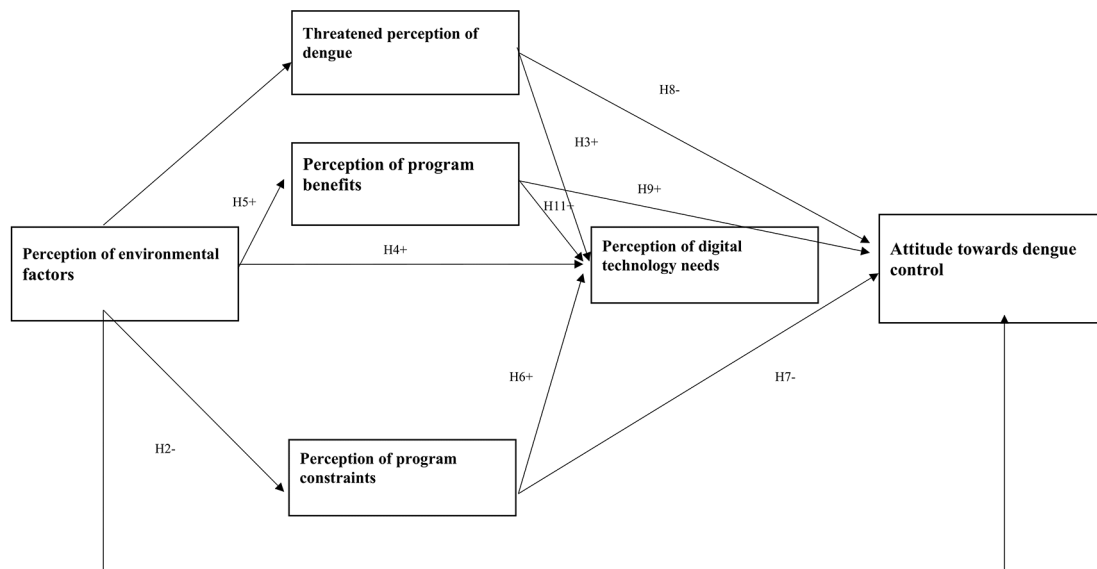


Figure 1. The structural hypothesis of the relationship between perception and attitude in dengue.³⁶

Various factors influence attitudes in efforts to control dengue. During the COVID-19 pandemic, social restrictions were carried out.³⁷ Social restrictions impact dengue control programs. Based on the theory of behavior change that a person is motivated to make prevention efforts when they feel seriously threatened and feel the benefits of intervention. The use of digital technology in dengue surveillance is also encouraged by the benefits of these digital applications and their ease of use. The health belief model approach is used because it is appropriate to form a model for changing attitudes towards dengue control related to perceptions of dengue threat, benefits of dengue control programs, and perceptions of constraints.^{38,39}

Environmental factors affect the transmission of dengue infection. Dengue is transmitted by the *Aedes aegypti* mosquito, which breeds in water containers. The large number of water containers in an environment can affect the density of mosquitoes. Climatic factors (temperature, humidity and rainfall), as well as population density, also increase dengue transmission.^{40,41} Environmental factors can increase the potential for dengue transmission in an area. The perception of environmental factors is essential to analyze.

Perceived ease of use and perceived benefits influence the perceived need for technology. This is in accordance with the Technology Acceptance Model (TAM).⁴² Several studies on TAM are related to public acceptance of an application.^{43–46} The use of dengue surveillance applications is needed to collect data and education. Digital applications can record quickly and integrate. This study uses a combination of several theories to create a suitable model according to stakeholder needs. The determinants of these variables are by the need to develop a dengue control attitude model related to technological needs and perceptions of environmental factors.

Based on the literature discussed, the hypotheses that emerged to provide the scope of this study are shown in [Table 1](#).

Study design and data collection

This cross-sectional study is conducted using an online survey with 6 variables.⁴⁷ These include perceptions of the need for digital information systems, dangers of DHF, benefits of DHF control programs, program constraints, and environmental factors related to attitudes toward controlling DHF. Respondents answered with a Likert scale of 1-5, where 1, 2, 3, 4, and 5 represent strongly disagree, disagree, neutral, agree, and strongly agree. The questionnaire was made by discussing with experts and testing about 30 respondents to measure the validity and reliability. Respondents were selected based on inclusion criteria, aged more than 17 years, having an address in Denpasar City for more than one year, and willing to answer questions. The results of the validity and reliability tests found that 46 of the indicators were declared valid. Invalid indicators are excluded and not used. The final questionnaire can be found as *Extended data*.⁴⁷

Table 1. Hypotheses providing the scope of this study.

Hypothesis 1 (H1).	Perceptions of environmental factors have a positive effect on perceptions of dengue threat
Hypothesis 2 (H2).	Perceptions of environmental factors have a positive effect on perceptions of program constraints
Hypothesis 3 (H3).	The perception of the dengue threat positively affects the perception of the need for digital technology
Hypothesis 4 (H4).	Perceptions of environmental factors have a positive effect on perceptions of digital technology needs
Hypothesis 5 (H5).	Perception of dengue threat has a positive effect on perceptions of program benefits
Hypothesis 6 (H6).	Perceptions of program constraints positively affect perceptions of digital technology needs
Hypothesis 7 (H7).	Perceived program constraints have a positive effect on attitudes toward dengue control
Hypothesis 8 (H8).	Perception of being threatened by dengue positively affects attitudes toward dengue control
Hypothesis 9 (H9).	Perceived benefits of the program positively affect attitudes toward dengue control
Hypothesis 10 (H10).	Perception of the need for digital technology positively affects attitudes toward dengue control
Hypothesis 11 (H11).	Perceptions of program benefits positively affect perceptions of digital technology needs

It was then distributed online using a google form, and data collection was carried out in the Denpasar City area, which is endemic to DHF. Table 2 shows a description of the data from the composites and indicators, as well as the definitions of attitudes towards dengue control efforts with the other five composites.

Jumantik is a volunteer recruited from each village area to inspect, monitor, and control dengue vectors. They were given the task of conducting daily inspections to visit homes. The results of their activities are reported as vector entomological surveillance. This is part of community empowerment to carry out dengue control in their area actively.

Table 2. Descriptive data.

Composite	Indicator	Definition
Perception of program benefits	Var1a	<i>Jumantik</i> volunteers always visit my house every month
	Var1b	<i>Jumantik</i> volunteers always provide information
	Var1c	<i>Jumantik</i> volunteers give larvicide
	Var1d	<i>Jumantik</i> program is useful for preventing dengue
	Var1e	Students can play the role of being a larva care student
	Var1f	I support the dengue control program
	Var1g	I am willing to follow <i>Jumantik</i> 's advice
Perception of being threatened with dengue	Var2a*	I am at risk of being infected with dengue
	Var2b*	My family is at risk for dengue infection
	Var2c	Dengue Haemorrhagic Fever (DHF) is a deadly disease
	Var2d*	Dengue is a highly contagious disease
	Var2e	Dengue Haemorrhagic Fever (DHF) is a dangerous disease
	Var2f	We are afraid of being infected with dengue
Perception of program constraints	Var3a	Program funding is still lacking
	Var3b	A limited number of health workers
	Var3c	Home visits are limited due to social distancing and COVID-19
	Var3d	Visiting hours during business hours from 8 to 10 AM
	Var3e*	Limited information
	Var3f*	Limited larvicides
	Var3g*	Brochure distribution is rarely done
	Var3h*	Limited smartphone facilities
Perception of digital technology needs	Var4a	I am willing to use my cell phone for the dengue control program
	Var4b	I am willing to fill in the data on the website
	Var4c	I am willing to watch digital educational videos
	Var4d	I am willing to share information with my family
	Var4e	Support dengue control digital information system
	Var4f	I have an android phone that supports the program
	Var4g	I have social media applications such as WhatsApp, Facebook, Instagram, and others
	Var4h*	Usually, use WhatsApp to communicate

Table 2. *Continued*

Composite	Indicator	Definition
Perception of environmental factors	Var5a	The rainy season affects the incidence of dengue
	Var5b	The number of water containers affects mosquito density
	Var5c*	Aedes mosquitoes like to lay their eggs in clean water
	Var5d	A bucket filled with water has the potential to become mosquito breeding place
	Var5e	Bath containers have the potential to become mosquito breeding places
	Var5f	Used bottles, used tires can become mosquito breeding places
	Var5g	Empty land has the potential to become mosquito breeding places
	Var5h	Environmental conditions affect dengue cases
Attitude towards dengue control	Var6a	I am willing to eradicate mosquito breeding places once a week
	Var6b	I am willing to close the water container
	Var6c	Carry out environmental cleaning activities once a week
	Var6d	Fill in larva density data every week
	Var6e	Support the program to eradicate mosquito breeding places
	Var6f	Support the activities of students caring for dengue every week
	Var6g*	I am willing to be penalized if larvae are found
	Var6h*	I am willing to pay a fine if a larva is found
	Var6i	Willing to make efforts to eradicate mosquito breeding places following the advice of the officer

*These indicators were not included in latent variables due to the multicollinearity criteria of PLS-SEM.

Sample

The inclusion criteria were respondents who were over 17 years old and had resided in Denpasar City for more than six months. They are willing to fill out a research approval form and receive mobile phone credit from the internet provider for two. Even though 596 respondents filled in the data, only 515 fulfilled the requirements and were complete. Sampling was carried out with non-random sampling conducted online in a limited population with the consideration that respondents could not be visited directly due to the COVID-19 pandemic in the Denpasar City area, which had previously been permitted by the Licensing Service, Health Service, Head of Public Health Center, and Village Head.

The online survey was chosen because it was appropriate during the Covid-19 pandemic. Online surveys are more accessible and cheaper than manual surveys using door to door.

Measurement of sample size using the following formulation.

$$S = Z^2 x P x (1 - P) / M^2$$

$$S = 1.96^2 x 0.5 x (1 - 0.5) / 0.05^2$$

$$S = 384$$

Notes:

S = Sample size for infinite population

P = Population proportion (Assumed as 50% or 0.5)

M = Margin of error = 5%

Z = The Z-score will be 1.96 if the confidence level is 95%

This means that: N = 384, z = 1.96, M = 0.05 and p = 0.5

Variables

This study consists of six variables with 46 indicators using a Likert scale of 1-5, where 1, 2, 3, 4, and 5 representing strongly disagree, disagree, neutral, agree, and strongly agree. Attitudes toward prevention strategies are a dependent variable that tends to act to regulate dengue in the surrounding environment through the use of vector control activities at breeding sites for mosquitoes. Therefore, nine indicators are measured, namely willingness to carry out a weekly movement to eradicate mosquito breeding areas, close water reservoirs, clean the environment regularly, filling in data on larval density weekly independently, providing assistance to dengue control programs, supporting students' weekly larvae care activities, willing to be sanctioned when larvae are discovered, willing to pay a fine, and making efforts to eradicate mosquito breeding areas following the officer's advice.

Perceptions of the benefits are related to the assessment of dengue control programs beneficial to the community. These consist of 7 indicators: *jumantik* volunteers always visit every month, the officers always provide information, the volunteers provide larvacide, the program is useful for preventing dengue cases, and students play a role for larvae, the dengue control program was supported, and the officer's advice was followed.

The perception of being threatened with dengue is a condition that causes feelings of fear and vulnerability to outbreaks which consist of 6 variables. These include the risk of being infected with dengue fever and several families at risk of being infected. Dengue fever is a deadly, easily contagious, and dangerous disease that people are afraid of being infected.

Perceptions of program constraints are obstacles in carrying out activities related to facilities and pandemic conditions in dengue control. These consist of 8 variables of limited program funding, *jumantik* personnel, home visit activities due to social distancing and COVID-19, visiting time, which is during working hours from 8 to 10, the information provided, the larvicides, and smartphone facilities.

The need for digital technology is a public perception of the support for implementing the systems in dengue control. These consist of 8 variables, namely being willing to use mobile phones for dengue control programs, filling in data on websites, watching digital educational videos, sharing information with family, supporting digital information system programs, having Android phones that support the program, having social media applications such as WhatsApp, Facebook, Instagram, and others, but accustomed to using WhatsApp to communicate.

Perception of environmental factors is the surrounding conditions that affect the density of larvae and dengue cases, both natural and artificial. These consist of 8 variables, namely the rainy season affects the incidence of dengue, the number of water reservoirs affects the density of mosquitoes, the *Aedes* mosquitoes lay eggs in clean water, the bucket filled with water in bathroom containers, used bottles, tires, and vacant places have the potential to become a breeding place.

Data analysis

This study was analyzed using PLS-SEM with SmartPLS 3.0 software. It analyzed five variables related to attitudes towards dengue control. The PLS-SEM analysis uses two stages, and the first describes the measurement model connecting the constructs and indicators to the theory. In the second stage, the structural model determines the determinants of the relationship between the construction and the hypothetical model.

Ethical approval

This study is part of a research carried out for the development of an integrated dengue control system. This study has been approved by the ethics committee of the Faculty of Public Health, University of Indonesia (Ket-416/UN2.F10.D11/PPM.00.02/2021). Before data collection, informants had received information about their goals, risks, and rights. In addition, a written consent form was given before the interview, and all information from participants is confidential and for this study only.

Results

Table 3 shows the socio-demographics of respondents who filled in the data for this study. There were 515 respondents, with 41.4% and 58.6% being men and women, respectively, with the highest education level being high school level with 62.3%. The respondents' age distribution was mainly 40-44 years old (19.4%) and 17-24 years (18.6%). The type of occupation was primarily private workers (29.3%) and housewives (17.9%).

Most sources of information used for dengue control are through social media such as WhatsApp, Facebook, Instagram, Tiktok, and others (37%). Most respondents find it easier to get information through social media. However, there has been a change in the sources due to the development of information technology. Another highest source of knowledge is television (23%), followed by digital educational videos (14.3%) and websites (10.6%) (**Figure 2**).³⁶

The types of information needed are the methods of controlling dengue, the dangers, symptoms of infection, characteristics of dengue-transmitting mosquitoes, the risk, the role of *jumantik* cadres, methods of eradicating mosquito breeding sites, and environmental factors. This information is needed to develop digital educational media for dengue control (**Figure 3**).³⁶

Table 3. Socio-demographic of respondents.

Respondent characteristics	Frequency	Percent
Gender		
Male	213	41.4
Female	302	58.6
Education		
Primary School	2	0.4
Junior High School	27	5.2
Senior High School	321	62.3
Diploma	59	11.5
Bachelor	106	20.6
Age (years)		
17-24	96	18.6
25-29	28	5.4
30-34	56	10.9
35-39	64	12.4
40-44	100	19.4
45-49	79	15.3
50-54	44	8.5
55-59	28	5.4
60	20	3.9
Occupation		
Unemployment	31	6.0
Civil servant	27	5.2
Health worker	58	11.3
Housewife	92	17.9
College student	86	16.7
Village head	15	2.9
Entrepreneur	48	9.3
Private sector employee	151	29.3
Teacher	7	1.4

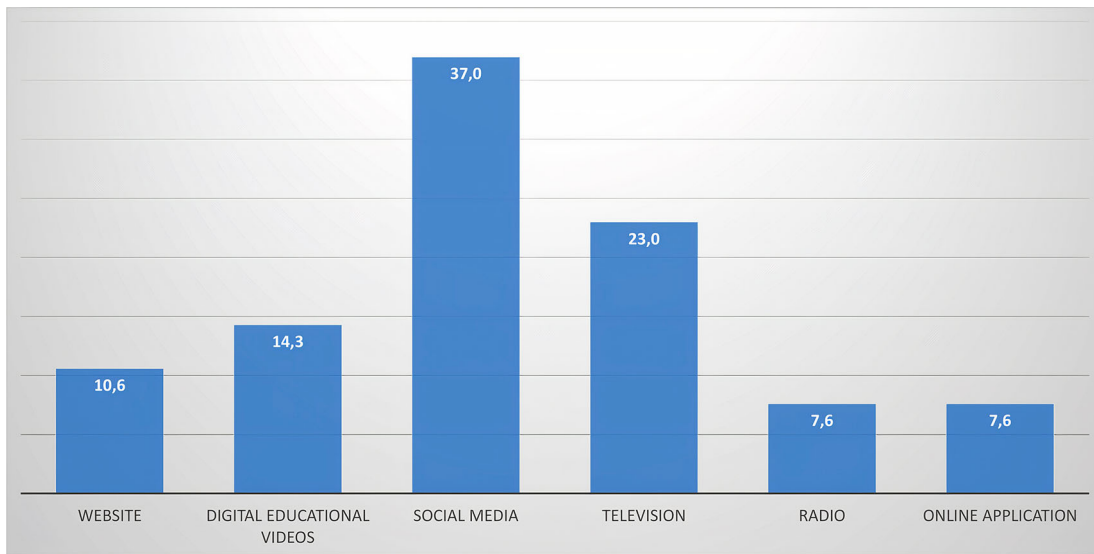


Figure 2. Percentage of sources of information technology needed regarding dengue control.³⁶

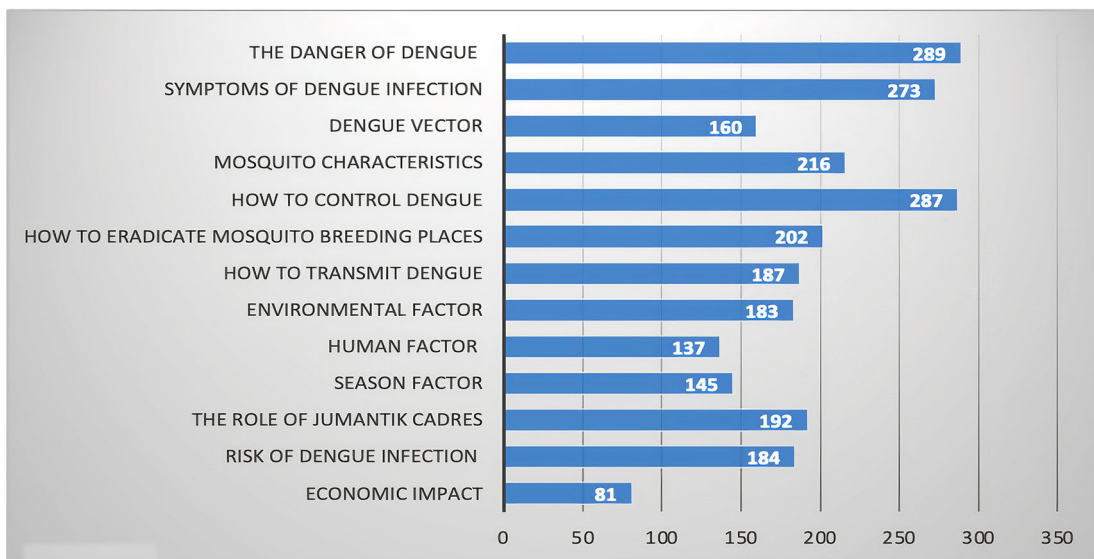


Figure 3. Types of information needed in dengue control.³⁶

The percentage of the community’s efforts to seek health services in handling dengue symptoms is through hospitals (44.5%) and primary health centers (40.5%). Public awareness to conduct health checks while experiencing symptoms of DHF is high in the urban setting in which the number and proximity of health-care services are relatively close and easily accessible (Figure 4).³⁶

This section details the results obtained for the proposed study model.

Measurement model

Composite mode A

The composite measurement model in mode A (attitude) was assessed in individual item reliability, construct reliability, convergent validity, and discriminant validity. First, the reliability of each item is analyzed through a loading factor, as seen in Figure 5.³⁶

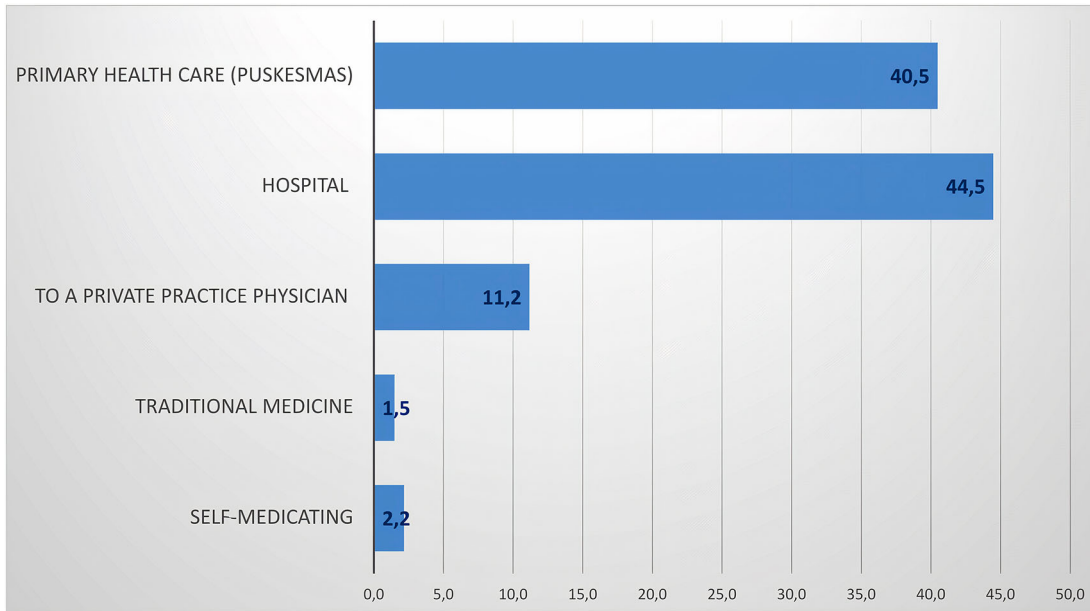


Figure 4. Percentage of seeking health services if infected with dengue.³⁶

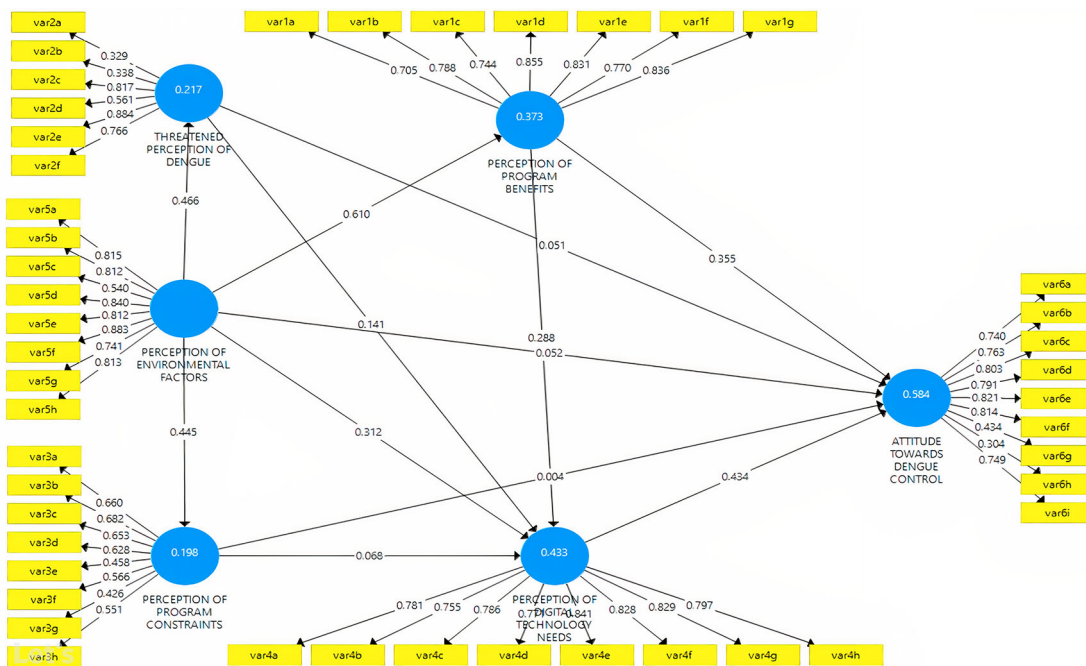


Figure 5. Study model.³⁶

Table 4 shows the value of the measurement of validity and reliability. Cronbach’s Alpha value and composite were used to evaluate construct reliability. The values show that the construct exceeds the recommended cut-off of 0.7. Convergent validity was also proved because the construct’s extracted mean-variance (AVE) was higher than 0.500. Table 4 shows that the measurement model meets the criteria.

Table 4. Validity and reliability measurement.

Composite	Cronbach’s Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Attitude Toward Dengue Control	0.901	0.921	0.627

Table 5. Heterotrait-monotrait (HTMT) inference.

HTMT inference*	Original sample	Sample mean	5%	95%
Perception Of Digital Technology Needs -> Attitude Towards Dengue Control	0.733	0.735	0.657	0.804
Perception Of Environmental Factors -> Attitude Towards Dengue Control	0.596	0.595	0.476	0.708
Perception Of Program Benefits -> Attitude Towards Dengue Control	0.714	0.717	0.637	0.793
Perception Of Program Constraints -> Attitude Towards Dengue Control	0.456	0.450	0.320	0.564
Threatened Perception Of Dengue -> Attitude Towards Dengue Control	0.486	0.484	0.358	0.611

*Significance, the confidence interval 95% bias was corrected and performed using bootstrap procedure with 10,000 replications.

Table 5 presents discriminant validity results through the heterotrait-monotrait (HTMT) correlation ratio. All constructs reach discriminant validity because the confidence interval does not contain a zero value. This situation means that each variable is different from one another. The data examined in the measurement model show that the attitude construct measure is reliable and valid.

Composite mode B

The composite measurement model in mode B was assessed in collinearity between the outer weights' indicators, significance, and relevance. First, removing the indicator is carried out when the value exceeds the variance impact factor (VIF = 3). As a result of this process, only the indicators shown in Table 2 are without collinearity. Second, the relevance of the weights is analyzed, and Figure 6³⁶ shows the indicators in construction for latent variables. Finally, it is possible to start a bootstrap with 10,000 sub-samples to assess significance. Indicators with insignificant weights but significant loadings of 0.50 or higher were considered relevant (Table 6).

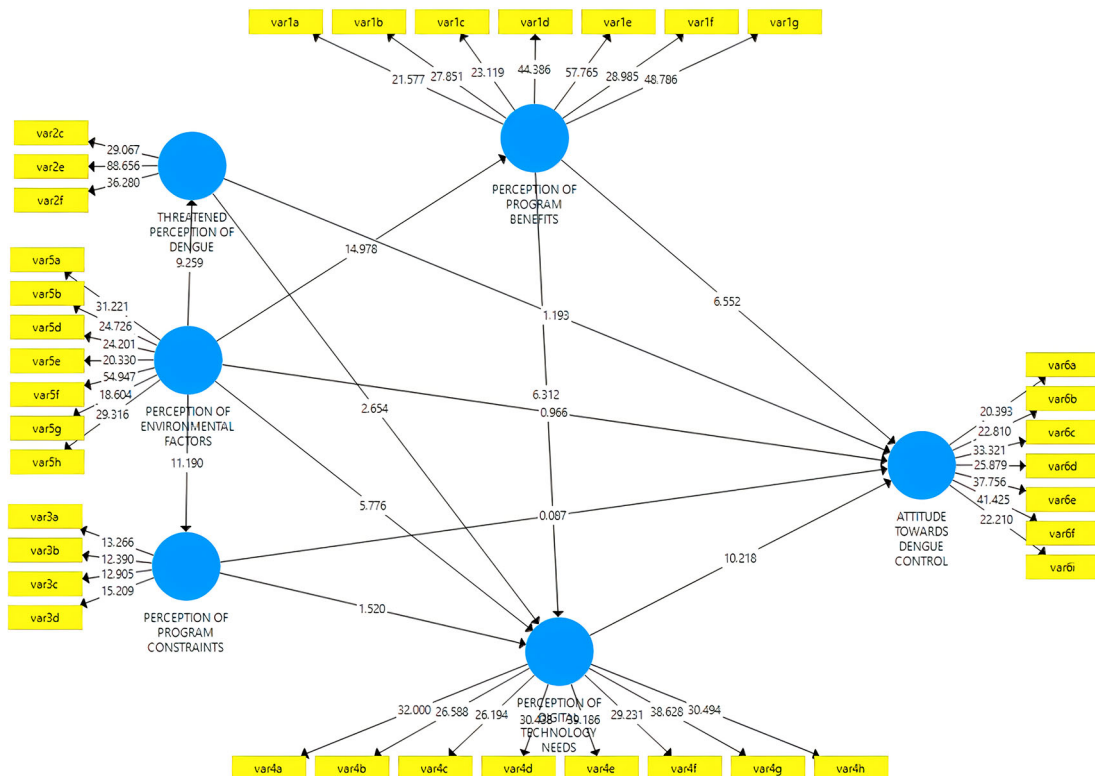


Figure 6. Model results SEM-PLS.³⁶

Table 6. Significance of weights.

	Original sample (O)*	t	Loading	Lo95	Hi95
Perception of program benefits					
Var1a	0.124	14.562	0.702	0.106	0.141
Var1b	0.142	17.507	0.786	0.125	0.156
Var1c	0.139	12.786	0.742	0.117	0.159
Var1d	0.181	22.076	0.855	0.166	0.199
Var1e	0.218	16.247	0.832	0.193	0.247
Var1f	0.217	16.050	0.772	0.193	0.244
Var1g	0.232	20.284	0.837	0.211	0.255
Threatened perception of dengue					
Var2c	0.364	16.095	0.831	0.319	0.407
Var2e	0.438	19.056	0.910	0.400	0.490
Var2f	0.364	13.604	0.820	0.306	0.412
Perception of program constraints					
Var3a	0.326	6.585	0.670	0.239	0.429
Var3b	0.265	6.616	0.666	0.188	0.339
Var3c	0.391	8.735	0.682	0.297	0.472
Var3d	0.479	8.557	0.706	0.382	0.600
Perception of digital technology needs					
Var4a	0.154	18.282	0.780	0.138	0.171
Var4b	0.132	17.528	0.752	0.118	0.146
Var4c	0.142	16.837	0.784	0.125	0.158
Var4d	0.182	20.493	0.774	0.165	0.201
Var4e	0.164	23.472	0.841	0.150	0.177
Var4f	0.158	17.940	0.828	0.141	0.175
Var4g	0.163	19.850	0.830	0.149	0.181
Perception of environmental factors					
Var5a	0.201	19.233	0.827	0.183	0.222
Var5b	0.167	17.922	0.820	0.150	0.187
Var5d	0.163	17.488	0.831	0.146	0.181
Var5e	0.158	17.032	0.804	0.139	0.176
Var5f	0.188	20.754	0.887	0.172	0.207
Var5g	0.160	17.451	0.745	0.145	0.181
Var5h	0.181	20.064	0.823	0.165	0.201
Attitude towards dengue control					
Var6a	0.163	21.560	0.753	0.149	0.179
Var6b	0.169	18.937	0.779	0.151	0.186
Var6c	0.171	19.730	0.815	0.157	0.189
Var6d	0.166	20.917	0.778	0.151	0.182
Var6e	0.202	23.747	0.835	0.188	0.220
Var6f	0.197	21.106	0.823	0.179	0.216
Var6i	0.194	18.306	0.754	0.175	0.215

*t statistic, and 95% bias-corrected confidence interval performed by a bootstrapping procedure with 10,000 replications.

Table 7. Whole sample results.

Direct effect	Path	t	p	Lo95	Hi95	f ²	VIF
Perception of Environmental Factors -> Threatened Perception of Dengue	0.478	9.259	0.000	0.378	0.583	0.296	1,000
R²=0.227							
Perception of Environmental Factors -> Perception of Program Constraints	0.471	11.190	0.000	0.392	0.553	0.285	1,000
R²=0.220							
Perception of Environmental Factors -> Perception of Program Benefit	0.606	14.978	0.000	0.532	0.689	0.580	1,000
R²=0.366							
Perception of Environmental Factors -> Perception of Digital Technology Needs	0.322	5.776	0.000	0.206	0.422	0.100	1,993
Perception of Program Benefits -> Perception of Digital Technology Needs	0.293	6.312	0.000	0.198	0.380	0.087	1,862
Perception of Program Constraints -> Perception of Digital Technology Needs	0.062	1.520	0.129 ^{ns}	-0.020	0.138	0.005	1,328
Threatened Perception of Dengue -> Perception of Digital Technology Needs	0.120	2.654	0.008	0.035	0.214	0.018	1,395
R²=0.427							
Perception of Digital Technology Needs -> Attitude Towards Dengue Control	0.405	10.218	0.000	0.333	0.479	0.219	1,765
Perception of Environmental Factors -> Attitude Towards Dengue Control	0.062	0.966	0.335 ^{ns}	-0.058	0.187	0.005	1,993
Perception of Program Benefits -> Attitude Towards Dengue Control	0.371	6.552	0.000	0.271	0.488	0.172	1,862
Perception of Program Constraints -> Attitude Towards Dengue Control	0.003	0.087	0.930 ^{ns}	-0.057	0.064	0.000	1,328
Threatened Perception of Dengue -> Attitude Towards Dengue Control	0.050	1.193	0.234 ^{ns}	-0.042	0.127	0.004	1,430
R²=0.571, Q²=0.569							
Indirect Effect	Path	t	p	Lo95	Hi95	VAF	VIF
Perception of Environmental Factors -> Perception of Digital Technology Needs--> Attitude Towards Dengue Control	0.487	10.269	0.000	0.398	0.587	0.511	na
Perception of Environmental Factors -> Threatened Perception of Dengue--> Attitude Towards Dengue Control	0.487	10.269	0.000	0.398	0.587	0.752	na
Perception of Environmental Factors -> Perception of Program Benefits--> Attitude Towards Dengue Control	0.487	10.269	0.000	0.398	0.587	0.469	na
Perception of Environmental Factors -> Perception of Program Benefits--> Perception of Digital Technology Needs	0.264	6.938	0.000	0.198	0.350	0.300	na
Perception of Program Benefits -> Perception of Digital Technology Needs--> Attitude Towards Dengue Control	0.119	5.267	0.000	0.074	0.165	0.152	na
Perception of Program Constraints -> Perception of Digital Technology Needs--> Attitude Towards Dengue Control	0.025	1.455	0.146 ^{ns}	-0.008	0.060	0.058	na
Threatened Perception of Dengue -> Perception of Digital Technology Needs--> Attitude Towards Dengue Control	0.049	2.626	0.009	0.015	0.085	0.097	na

Note: ns=not significant. t statistic, and confidence 95% bias was corrected. The interval was performed using a bootstrap procedure with 10,000 replication. VIF: Inflation of model variance in factors; VAF: variance recorded.

Structural model

The structural model is evaluated after verifying the correctness of the construction measurements. The path coefficients and their 10,000 resampling bootstrap significance levels are reported in [Table 7](#) and [Figure 6](#).³⁶ Additionally, [Table 7](#) shows that the VIF constructs range from 1,000 to 1,700, indicating no collinearity between variables. This study also assesses the quality by examining the overall predictive relevance of the model with a Q2 value above zero which indicates a fit in the prediction model. The magnitude of Q2 has a value of $0 < Q2 < 1$, where the closer to 1, the better the model. The coefficient of determination (R2) also exceeds 0.1 for endogenous latent variables since the construct has an acceptable predictive power quality.

From [Table 7](#), there is a direct influence of Perception of Environmental Factors on the Threatened Perception of Dengue, Program Constraints, Program Benefits, and Digital Technology Needs. Perception of Program Benefits and Threatened Perception of Dengue directly influences Digital Technology Needs. In general, Perception of Digital Technology Needs and Program Benefits directly influence Attitude Towards Dengue Control. Variables Perception of Digital Technology Needs and Perception of Program Benefits positively correlate to Attitude Towards Dengue Control.

VAF values above 80% indicate that the variable serves as a full mediator. The variable can be categorized as a partial mediator when the VAF value ranges from 20% to 80%. However, when the value is less than 20%, it can be concluded that there is almost no mediating effect. The value of VAF indicates that the proportion of Perception Of Digital Technology Needs from the pathway has no mediating effect (VAF<0.2 or 20%). Perception of Digital Technology Needs, Threatened Perception of Dengue, and Program Benefits can be categorized as partial mediators between Environmental Factors and Attitudes Towards Dengue Control (see the indirect effect in [Table 7](#)).

Discussion

This study aimed to determine the variables that influence attitudes in dengue control related to the potential application of digital technology. It indicates a direct influence of Perception of Environmental Factors on Threatened Perception of Dengue, Program Constraints, Program Benefits, and Digital Technology needs. Perception of Program Benefits and Threatened Perception of Dengue directly Influences Digital Technology Need. Perception of Digital Technology Needs and Program Benefits directly influence Attitude Towards Dengue Control.

Dengue is still a public health problem in Asia, especially in tropical countries like Indonesia. Even during the COVID-19 pandemic, dengue became a double disease burden.⁴⁸ During the COVID-19 pandemic, there was an increase in dengue infection, while dengue monitoring and control activities were limited in several countries.⁴⁹ This condition poses a severe threat to dengue-endemic areas.

Several studies have shown that dengue control measures are essential. Empowering the community to carry out activities to control water containers where mosquitoes breed is effective in preventing dengue infection.^{50–52} The *Aedes aegypti* mosquito as the primary vector needs to be eliminated.⁵³ This attitude in controlling dengue is the primary key to preventing dengue outbreaks.⁵⁴

Digital health surveillance technologies assist in disease prevention, detection, tracking, reporting and analysis.^{55,56} The development of digital technology supported by the infrastructure can assist in reporting. An integrated digital surveillance system is needed for dengue control.

The variable perception of the need for digital technology and program benefits directly influences attitudes toward dengue control. This is related to the source of information obtained through digital media. Perception of environmental factors is influenced by Threatened Perception of Dengue, Program Constraints, Program benefits, and Digital Technology Needs.

The use of digital technology in dengue surveillance is currently needed, specifically during the COVID-19 pandemic. Health protocols such as social and physical distancing make direct door-to-door observation activities difficult. Therefore, there is an increase in smartphones and digital applications in conducting disease surveillance.

This study is a novelty in developing a new model that adopts the health belief model and then collaborates between digital information systems with perceptions of environmental factors, disease threats, and the obstacles related to dengue control attitudes. This study begins with a qualitative study of the potential development of digital surveillance for dengue control, which requires a digitally integrated system for reporting in real-time.³¹

Other studies showed an increase in the use of digital technology during the pandemic for monitoring, surveillance, detection, and prevention of COVID-19.^{57,58} Studies in Saudi use various digital platforms such as mobile health applications, artificial intelligence, and machine learning in the pandemic surveillance.⁵⁹ A digital dengue surveillance system has also been developed to predict, detect and control the threat of outbreaks.^{60–62} The incidence is often related to climate change, ecological and socio-demographic factors.^{63–67} Developing a system based on technology and the environment using spatial mapping makes it possible to predict the potential for outbreaks in an area.^{68,69}

Study strengths and limitations

The strength is the development of a model that combines measurement of attitudes towards dengue control with environmental factors on the threatened perception of dengue, program constraints, program benefits, and digital technology needs. The commonly used model is the health belief, but a different approach combines the perceived need for digital technology, environmental factors, and health beliefs.

This study uses PLS-SEM analysis which selected because it is variance-based and estimates composite components and factors.⁷⁰ The PLS analysis is a multivariate statistical technique that compares several responses and explanatory variables.^{22,71,72} Through this approach, it is possible to make appropriate structural equations toward dengue control related to the perception of environmental factors on the threatened perception of dengue, program constraints, program benefits, and digital technology needs.

The use of online surveys is limited to certain areas and does not represent the whole of Indonesia, only Denpasar City. Generally, the respondents used were those with mobile phones and internet networks, and they were not randomly assigned.

Policy implications and future studies

This study adds to the literature and provides a comprehensive understanding related to attitudes in dengue control, perceptions of program benefits, perceptions of dengue threats, perceptions of constraints, perceptions of the need for digital technology, and perceptions of environmental factors.^{39,73} This study also contributes to supporting the health belief model.^{30,74} This study has added to the theoretical literature by developing a structural model related to dengue control attitudes, especially in Indonesia.

The results are helpful for policymakers to promote the use of digital technology in data collection of disease cases, surveillance, monitoring, and evaluation of health programs supported by socialization through social media that can influence perceptions of the benefits of the program. The community's attitude toward controlling the disease is also related to the source of information that affects public perception. Policies to support digital facilities such as the availability of internet networks, computer facilities, mobile phones, and data packages affect the disease reporting system and its control. In the future, it is necessary to develop an integrated digital system for reporting disease cases and collecting data on the ecological environment, specifically larval density. This system should perform spatial mapping and predict the potential for a dengue outbreak to occur. Therefore, technology can be helpful in case surveillance for quick control measures.

Conclusion

Digital technology has the potential to be developed during the COVID-19 pandemic, specifically in conducting data collection, surveillance, reporting, monitoring, and evaluation. Attitudes towards dengue control directly affect the perception of digital technology needs and program benefits. Social media is a more dominant source of information about dengue disease than other forms of electronic media. The perception of environmental factors is also directly influenced by the variables of threatened perception of dengue, program constraints, program benefits, and digital technology needs.

Data availability

Underlying data

Dryad: Attitude towards dengue control efforts with the potential of digital technology during COVID-19: partial least squares-structural equation modelling, <https://doi.org/10.5061/dryad.jdfn2z3f0>.⁷⁵

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Extended data

Figshare: Partial Least Squares-Structural Equation Modelling for Attitude Towards Dengue Control Efforts using the Potential of Digital Technology During COVID-19, <https://doi.org/10.6084/m9.figshare.20499903.v1>.³⁶

Figshare: Dengue integrated surveillance system questionnaire, <https://doi.org/10.6084/m9.figshare.21300309.v1>.⁴⁷

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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Mohammad Khaleel Okour 

Business Administration Department, Philadelphia University, Amman, Jordan

All required amendments have been made successfully. Thank you. I enjoyed reading this research.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Technology Diffusion, Knowledge Management, Innovation Management

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 04 July 2023

<https://doi.org/10.5256/f1000research.149494.r181881>

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Ahmad Firdhaus Arham 

Pusat Pengajian Citra Universiti, Bangi, Malaysia

All is good. Excellent.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Consumer Behavior on Contemporary Science, Tehnology and Sustainable Development Issues, SPSS and PLS-SEM.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 19 May 2023

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**Ahmad Firdhaus Arham**

Pusat Pengajian Citra Universiti, Bangi, Malaysia

Introduction

- Lacks information about digital technology.
- What is the real problem statement? Why was this study needed, please relate strong problem statement.

Methodology

- Please bring out the variables section in your methodology. Suggest putting in the Theoretical Framework after introduction.
- Not Proper, to explain variables in your method, if you want to explain how the the variables and the items develop should be ok.

Analysis and result

- Please clarify your model fit or not - please test it.

Discussion

- Please focus on your results. What is your major finding in the first paragraph?

Overall, technically sounds ok.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Consumer Behavior on Contemporary Science, Tehnology and Sustainable Development Issues, SPSS and PLS-SEM.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 28 May 2023

Dewi Susanna

Thank you very much for giving any comment for improvements. Here, we tried to respond your comments as follow:

Introduction

1. Lacks information about digital technology.

Response:

The research objectives have been adjusted to:

This study aims to identify critical indicators influencing attitudes towards dengue control related to the potential for implementing digital technology.

Digital technology has developed rapidly in the health sector. Digital technology is beneficial during the Covid-19 pandemic for conducting dengue surveillance. The existence of a social restriction policy with social distancing has caused the door-to-door control program not to be implemented [11], [12], [13].

1. What is the real problem statement? Why was this study needed, please relate strong problem statement.

Responses:

Attitudes in dengue control are essential because they can influence control measures. This model is needed in analyzing variables related to attitudes and the use of digital applications in conducting dengue surveillance. This study will obtain a potential model that can be used as a digital innovation for dengue control. This study aims to identify critical indicators influencing attitudes towards DHF control related to the potential for implementing digital technology.

Methodology

1. Please bring out the variables section in your methodology. Suggest putting in the Theoretical Framework after introduction.

Response:

We have separated the Theoretical Framework after introduction. We have also explained in detail about the conceptual model and hypothesis before the method.

1. Not Proper, to explain variables in your method, if you want to explain how the the variables and the items develop should be ok.

Responses:

In the partial least square-structural equation modelling (PLS-SEM) method, explaining the variables being analyzed is essential. This explanation facilitates the reader's understanding of the definition of these variables. The symbol of each variable needs to be defined so that it has the same meaning. It has been included in the research method.

Analysis and result

1. Please clarify your model fit or not - please test it.

Responses:

An explanation of the structural model fit has been given in Table 6. The structural model is evaluated after verifying the correctness of the construction measurements. The path coefficients and their 10,000 resampling bootstrap significance levels are reported in Table 6 and Figure 6. Additionally, Table 6 shows that the VIF constructs range from 1,000 to 1,700, indicating no collinearity between variables. This study also assesses the quality by examining the overall predictive relevance of the model with a Q2 value above zero which indicates a fit in the prediction model. The magnitude of Q2 has a value of $0 < Q2 < 1$, where the closer to 1, the better the model. The coefficient of determination (R2) also exceeds 0.1 for endogenous latent variables since the construct has an acceptable predictive power quality.

Discussion

1. Please focus on your results. What is your major finding in the first paragraph?

Responses:

A discussion of results and discussion has been added, as described below:

This study aimed to determine the variables that influence attitudes in dengue control related to the potential application of digital technology. It indicates a direct influence of Perception of Environmental Factors on Threatened Perception of Dengue, Program Constraints, Program Benefits, and Digital Technology needs. Perception of Program Benefits and Threatened Perception of Dengue directly Influences Digital Technology Need. Perception of Digital Technology Needs and Program Benefits directly influence Attitude Towards Dengue Control.

Dengue is still a public health problem in Asia, especially in tropical countries like Indonesia. Even during the COVID-19 pandemic, dengue became a double disease burden⁴⁶. During the COVID-19 pandemic, there was an increase in dengue infection, while dengue monitoring and control activities were limited in several countries⁴⁷. This condition poses a

severe threat to dengue-endemic areas.

Several studies have shown that dengue control measures are essential. Empowering the community to carry out activities to control water containers where mosquitoes breed is effective in preventing dengue infection^{48, 49, 50}. The *Aedes aegypti* mosquito as the primary vector needs to be eliminated⁵¹. This attitude in controlling dengue is the primary key to preventing dengue outbreaks⁵².

Digital health surveillance technologies assist in disease prevention, detection, tracking, reporting and analysis^{53, 54}. The development of digital technology supported by the infrastructure can assist in reporting. An integrated digital surveillance system is needed for dengue control.

The variable perception of the need for digital technology and program benefits directly influences attitudes toward dengue control. This is related to the source of information obtained through digital media. Perception of environmental factors is influenced by Threatened Perception of Dengue, Program Constraints, Program benefits, and Digital Technology Needs.

1. Overall, technically sounds ok.

Response:

Thank you very much for your appreciation.

Overall, thank you for all the input so this article can be even better.

Regards,

Tim.

Competing Interests: The authors do not have conflict of interest.

Reviewer Report 05 December 2022

<https://doi.org/10.5256/f1000research.137611.r156148>

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Mohammad Khaleel Okour

Business Administration Department, Philadelphia University, Amman, Jordan

I appreciate the effort that the authors did in this manuscript. However, I have some apprehensions which I have highlighted below:

Introduction

- The authors mainly explained the lack of understanding of the factors that influence attitudes toward dengue control concerning the potential application of digital technology

in Indonesia. It will be more beneficial if they could provide further evidences based on previous studies from the context of Southeast Asia countries; specifically, Indonesian context.

Literature review

- I could not find any serious attempt to write a literature review related to the variables of the study. Researchers should create a new separate section that discuss the previous conducted studies in this field of research (based on the study model).

Method

- As the study is deductive in nature, the authors should clarify the rationale behind adopting the health belief theory. In its current form, there is not enough theoretical justification to propose the study hypotheses.
- The authors need to make sufficient justification on how they determined the sample size?
- A standard PLS-SEM methodology was utilized. More evidence should be provided that the statistical assumptions of PLS-SEM have been fulfilled before using it.
- In term of the study respondent characteristics, were there no respondents with master's or doctoral degrees?
- The authors must write the hypotheses of the study clearly and explicitly. For better readability, I recommend the authors create a new table that includes the hypothesis statement with its result (supported / not supported).

Discussion

- Based on the study model, I don't see a significant attempt to discuss the study findings. Authors must provide a detailed discussion that includes sufficient linkage/justification between the study findings with previous recent studies.

Implication

- The authors have focused on the practical/ managerial implications of the study. On the other hand, the authors have not given explicit discussion/ examples of theoretical implications.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

No source data required

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Technology Diffusion, Knowledge Management, Innovation Management

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 28 May 2023

Dewi Susanna

Thank you very much for giving any comments of our manuscript.

We are very sorry for delaying posting these responses since we are highly recommended to wait for another reviewer's report.

We have discussed it to make our manuscript more understandable for readers.

Here are our responses to all comments:

Introduction

Question:

The authors mainly explained the lack of understanding of the factors that influence attitudes toward dengue control concerning the potential application of digital technology in Indonesia. It will be more beneficial if they could provide further evidences based on previous studies from the context of Southeast Asia countries; specifically, Indonesian context.

Response:

Additional information has been added in the text. An explanation of this has been included in the background

During the COVID-19 pandemic, efforts to control dengue were hampered due to the limited door-to-door educational activities. Therefore, the use of digital technology can help carry out surveillance and education to the public. There are several studies in Indonesia regarding attitudes toward dengue control. A study in Kupang, Indonesia, explains that a significant relationship exists between knowledge, attitudes, and actions in controlling dengue¹¹. Likewise, other studies in Indonesia show that knowledge and attitudes influence dengue prevention measures^{12,13}. Another study in Indonesia on community perspectives on electronic-based dengue vector surveillance during the COVID-19 pandemic¹⁴. There are also studies on developing a mobile-based dengue surveillance information system as an early warning system^{15,16}.

Digital technology has developed rapidly in the health sector. Digital technology is beneficial during the Covid-19 pandemic for conducting dengue surveillance. The existence of a social restriction policy with social distancing has caused the door-to-door control program not to be implemented^{17, 18, 19}.

Attitudes in dengue control are essential because they can influence control measures. This model is needed in analyzing variables related to attitudes and the use of digital applications in conducting dengue surveillance. This study will obtain a potential model that can be used as a digital innovation for dengue control. This study aimed to identify critical indicators influencing attitudes towards DHF control related to the potential for implementing digital technology.

Literature review

Question:

I could not find any serious attempt to write a literature review related to the variables of the study. Researchers should create a new separate section that discuss the previous conducted studies in this field of research (based on the study model).

Responses:

The Literature Review has been written in the paper as below:

Literature review

The co-epidemic trend of COVID-19 and dengue in Southeast Asia needs serious attention. These two diseases have similar clinical symptoms^{20, 21}. The COVID-19 pandemic situation is a challenge in controlling dengue in Indonesia. The existence of a social restriction policy makes it difficult for volunteers to provide education manually door to door. The impact is increased dengue cases in several areas²².

Public awareness regarding dengue control efforts still needs to be improved. Knowledge related to dengue can influence attitudes toward dengue control^{23, 24}. A positive attitude can encourage action to control dengue^{25, 26}. A large number of water containers is a breeding ground for mosquitoes. This is a potential mosquito breeding site that needs to be controlled. Several studies also state that interventions are needed to increase knowledge, attitudes, and actions in controlling dengue^{27, 28, 29}. Perceptions of the threat to the disease and the benefits of the interventions also influence attitudes towards dengue control. This is in accordance with the concept of the health belief model³⁰.

Attitudes towards dengue control using digital technology need to be studied for the driving and inhibiting factors. Intervention with digital technology requires supporting facilities and infrastructure^{18, 17}. Digital educational media that can increase public knowledge is needed during the COVID-19 pandemic. Through socialization with digital educational media, prevention activities can be carried out widely despite a social distancing

policy.

The development of digital technology has helped health services to provide fast and integrated services. Particularly in dengue control, digital interventions can help conduct surveillance of areas with mosquito density, larval density, and several dengue cases so that they can make a priority scale^{31, 32}. Utilization of digital technology in conducting digital data collection and education can provide early detection and response to dengue cases in an area.

Method

Question:

As the study is deductive in nature, the authors should clarify the rationale behind adopting the health belief theory. In its current form, there is not enough theoretical justification to propose the study hypotheses.

Response:

Conceptual model and hypotheses

The theoretical model adopts a health belief model between perceptions and dengue control behaviour.^{11 - 13} The health belief theory is then modified by adding environmental variables and the need for digital technology. The hypotheses were compared with six latent constructs related to dengue control attitudes, influenced by perceptions of the threat of dengue, program benefits, environmental factors, program constraints, and technology needs (Figure 1). The direction of the path shows the (+) and (-) effects of the relationship, and this study assessed the accuracy of the model and hypothesis with PLS-SEM.

Various factors influence attitudes in efforts to control dengue. During the COVID-19 pandemic, social restrictions were carried out³⁶. Social restrictions impact dengue control programs. Based on the theory of behavior change that a person is motivated to make prevention efforts when they feel seriously threatened and feel the benefits of intervention. The use of digital technology in dengue surveillance is also encouraged by the benefits of these digital applications and their ease of use. The health belief model approach is used because it is appropriate to form a model for changing attitudes towards dengue control related to perceptions of dengue threat, benefits of dengue control programs, and perceptions of constraints^{37, 38}.

Environmental factors affect the transmission of dengue infection. Dengue is transmitted by the *Aedes aegypti* mosquito, which breeds in water containers. The large number of water containers in an environment can affect the density of mosquitoes. Climatic factors (temperature, humidity and rainfall), as well as population density, also increase dengue transmission^{39, 40}. Environmental factors can increase the potential for dengue transmission in an area. The perception of environmental factors is essential to analyze.

Perceived ease of use and perceived benefits influence the perceived need for technology.

This is in accordance with the Technology Acceptance Model (TAM)⁴¹. Several studies on TAM are related to public acceptance of an application^{42, 43, 44, 45}. The use of dengue surveillance applications is needed to collect data and education. Digital applications can record quickly and integrate. This study uses a combination of several theories to create a suitable model according to stakeholder needs. The determinants of these variables are by the need to develop a dengue control attitude model related to technological needs and perceptions of environmental factors.

Question:

The authors need to make sufficient justification on how they determined the sample size?

Response:

The calculation of minimum sample was calculated using a formulae and added it in the text as follow:

The online survey was chosen because it was appropriate to do it during the Covid-19 pandemic. Online surveys are easier and cheaper than manual surveys using door to door. Measurement of sample size using the following formulation:

$$S = Z^2 \times P \times (1 - P) / M^2$$
$$S = (1.960)^2 \times 0.5 \times (1 - 0.5) / 0.05^2 = 3.8416 \times 0.25 / 0.0025$$
$$S = 384.16$$

Notes:

S = Sample size for infinite population

P = Population proportion (Assumed as 50% or 0.5)

M = Margin of error = 5%

Z = The Z-score will be 1.96 if the confidence level is 95%

This means that: n = 384, z = 1.96, M = 0.05 and p = 0.5

Question:

A standard PLS-SEM methodology was utilized. More evidence should be provided that the statistical assumptions of PLS-SEM have been fulfilled before using it.

Response:

Measurement Model

Composite Mode A

The composite measurement model in mode A (attitude) was assessed in individual item reliability, construct reliability, convergent validity, and discriminant validity. First, the reliability of each item is analyzed through a loading factor, as seen in Figure 5.

Question:

In term of the study respondent characteristics, were there no respondents with master's or

doctoral degrees?

Response:

The selected respondents were the general public who were willing to be involved in the Denpasar area, Bali. The results of the survey showed that there were no respondents with master's and doctoral degrees.

Question:

The authors must write the hypotheses of the study clearly and explicitly. For better readability, I recommend the authors create a new table that includes the hypothesis statement with its result (supported / not supported).

Response:

Based on the literature discussed, the following hypotheses emerge to provide the scope of this study:

Hypothesis 1 (H1). Perceptions of environmental factors have a positive effect on perceptions of dengue threat.

Hypothesis 2 (H2). Perceptions of environmental factors have a positive effect on perceptions of program constraints.

Hypothesis 3 (H3). The perception of the dengue threat positively affects the perception of the need for digital technology.

Hypothesis 4 (H4). Perceptions of environmental factors have a positive effect on perceptions of digital technology needs.

Hypothesis 5 (H5). Perception of dengue threat has a positive effect on perceptions of program benefits.

Hypothesis 6 (H6). Perceptions of program constraints positively affect perceptions of digital technology needs.

Hypothesis 7 (H7). Perceived program constraints have a positive effect on attitudes toward dengue control.

Hypothesis 8 (H8). Perception of being threatened by dengue positively affects attitudes toward dengue control.

Hypothesis 9 (H9). Perceived benefits of the program positively affect attitudes toward dengue control.

Hypothesis 10 (H10). Perception of the need for digital technology positively affects

attitudes toward dengue control.

Hypothesis 11 (H11). Perceptions of program benefits positively affect perceptions of digital technology needs.

Discussion

Question:

Based on the study model, I don't see a significant attempt to discuss the study findings. Authors must provide a detailed discussion that includes sufficient linkage/justification between the study findings with previous recent studies.

Response:

Several research results have been added in the text.

"This study aimed to determine the variables that influence attitudes in dengue control related to the potential application of digital technology. It indicates a direct influence of Perception of Environmental Factors on Threatened Perception of Dengue, Program Constraints, Program Benefits, and Digital Technology needs. Perception of Program Benefits and Threatened Perception of Dengue directly Influences Digital Technology Need. Perception of Digital Technology Needs and Program Benefits directly influence Attitude Towards Dengue Control.

Dengue is still a public health problem in Asia, especially in tropical countries like Indonesia. Even during the COVID-19 pandemic, dengue became a double disease burden⁴⁶. During the COVID-19 pandemic, there was an increase in dengue infection, while dengue monitoring and control activities were limited in several countries⁴⁷. This condition poses a severe threat to dengue-endemic areas.

Several studies have shown that dengue control measures are essential. Empowering the community to carry out activities to control water containers where mosquitoes breed is effective in preventing dengue infection^{48, 49, 50}. The *Aedes aegypti* mosquito as the primary vector needs to be eliminated⁵¹. This attitude in controlling dengue is the primary key to preventing dengue outbreaks⁵².

Digital health surveillance technologies assist in disease prevention, detection, tracking, reporting and analysis^{53, 54}. The development of digital technology supported by the infrastructure can assist in reporting. An integrated digital surveillance system is needed for dengue control.

The variable perception of the need for digital technology and program benefits directly influences attitudes toward dengue control. This is related to the source of information obtained through digital media. Perception of environmental factors is influenced by Threatened Perception of Dengue, Program Constraints, Program benefits, and Digital Technology Needs."

Implication

Question:

The authors have focused on the practical/ managerial implications of the study. On the other hand, the authors have not given explicit discussion/ examples of theoretical implications.

Response:

Thank you for your input. For theoretical benefits, we have added that through this study a model for the development of science regarding attitude factors in controlling dengue with digital technology has been found. Quotations have been included in the article:

“This study adds to the literature and provides a comprehensive understanding related to attitudes in dengue control, perceptions of program benefits, perceptions of dengue threats, perceptions of constraints, perceptions of the need for digital technology, and perceptions of environmental factors^{38,71}. This study also contributes to supporting the health belief model^{30,72}. This study has added to the theoretical literature by developing a structural model related to dengue control attitudes, especially in Indonesia.”

Overall, thank you for all the input so this article can be even better.

Regards,
Tim.

Competing Interests: We declare that we do not have conflict of interest.

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