

Multilevel Analysis on Factors Affecting Caries Preventive Behavior among Primary School Children: Application of Health Belief Model

Dewi Mustika Ratih¹⁾, Yulia Lanti Retno Dewi²⁾,
Bhisma Murti¹⁾

¹⁾Masters Program in Public Health, Universitas Sebelas Maret

²⁾ Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: Dental caries (tooth decay) is a problem of children's dental health in the world. Primary school age is a strategic group for the precaution of dental and oral diseases. There is a transition from baby teeth to permanent teeth in the early childhood. Primary school age children do not have good self-care behavior. Therefore, they need parental supervision such as maintenance of dental and oral health. The theory of Health Belief Model (HBM) is used by the community to take positive health action such as precaution of a disease. This study aimed to analyze the caries preventive behavior by using the theory of the Health Belief Model.

Subjects and Method: This study used analytic observational method with cross sectional approach. This study was conducted at 25 Primary Schools, Klaten Regency, in September 2019. This study used stratified proportional random sampling and random sampling techniques of 200 primary school children at 25 primary schools in Klaten Regency as the sampling technique. The dependent variable was caries preventive behavior. The independent variables were perceived susceptibility, perceived severity, perceived benefit, and perceived barrier. This study used questionnaires to collect the data. The data were analyzed by using multilevel analysis on Stata 13.

Results: Caries preventive behavior increased with perceived susceptibility ($b=0.89$; 95%CI=0.85 to 1.69; $p=0.030$), perceived severity ($b=1.59$; 95%CI=2.73 to 0.44; $p=0.006$), perceived benefit ($b=1.05$; 95%CI=1.97 to 0.12; $p=0.026$), and perceived barrier ($b=-1.54$; 95%CI=-2.84 to 0.25; $p=0.019$). The variation of caries preventive behavior by 7% was determined by variables at the primary school level. This rate was smaller than the standard size of rule of thumb by 8-10%. Therefore, there was a contextual effect shown from the multilevel analysis, but the result was statistically low.

Conclusion: There is an effect of perceived susceptibility, perceived severity, perceived benefit, and perceived barrier on caries preventive behavior in primary school children. There is a contextual effect of primary school on caries preventive behavior based on the theory of Health Belief Model, but the result was statistically low.

Keywords: multilevel analysis, primary school children, theory of Health Belief Model, precaution of caries.

Correspondence:

Dewi Mustika Ratih, Masters Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: dewiratih1822@gmail.com. Mobile: +625640041822

BACKGROUND

Dental caries is a child's health problem. Based on data from the World Health Organization (WHO), the incidence of caries in children was 60-90%. Based on studies in European, American and Asian countries,

including Indonesia, 90-100% of children under 18 were affected by dental caries. According to the Oral Health Media Center, 60-90% of school-age children and almost all adults around the world had dental problems (WHO, 2017).

The prevalence of active caries in Indonesia increased, from 43.4% (2013) to 57.6% (2018). Central Java Province has dental and oral health problems by 56% (Basic Health Research, 2018).

Dental caries, one of the main public health problems in the world, is a disease of dental hard tissues caused by bacteria. It begins with plaque formation. Besides, it is characterized by the process of demineralization of enamel, dentin, and cementum. Dental caries is one of the dental and oral diseases. Dental caries occurs due to the damage of dental hard tissue which includes enamel, dentin, and cementum (Putri et al., 2012).

Primary school age children (6-12 years) are susceptible and critical age because they are susceptible to dental caries. In addition, the transition from baby teeth to permanent teeth occurs. Primary school age is a strategic group for the precaution of dental and oral diseases. There is a transition from baby teeth to permanent teeth in the early childhood. Primary school age children do not have good self-care behavior. Therefore, they need parental supervision such as maintenance of dental and oral health (Koizer *et al.*, 2011).

The theory of Health Belief Model (HBM) is used to encourage the community to take positive health action such as precaution of dental caries. This theory shows that individuals, in taking precaution of a disease, or to behave healthily are affected by perceived susceptibility, perceived severity, perceived benefit, and perceived barrier. It can affect someone to do healthy behavior (Sulaeman, 2016).

SUBJECTS AND METHOD

1. Study Design

This study used analytic observational method with cross sectional approach. This

study was conducted at 25 Primary Schools, Klaten Regency, in September 2019.

2. Population and Sample

The population of the study was all primary school children in Klaten Regency. The sample of the study was 200 subjects of the study. This study used stratified proportional random sampling at the second level, namely primary school level. This study also used simple random sampling at the individual level. This technique was chosen because the researcher would choose a sample at each primary school in a simple random. The sample was selected from 25 primary school units in Klaten Regency area. As a result, there were 8 study subjects that were selected.

3. Study Variables

The dependent variable was caries preventive behavior. The independent variables were perceived susceptibility, perceived severity, perceived benefit, and perceived barrier.

4. Operational Definition of Variables

Perceived susceptibility was the positive or negative assessment that the individuals had the risk to prevent caries. This study used questionnaires as the measurement instrument. This study used continuous data scale. The data was converted into a dichotomy to facilitate analysis. Code 0= low value of perceived susceptibility and 1= high value of perceived susceptibility.

Perceived Severity/Seriousness was an individual's subjective perception on how severe the consequences of caries are. The data were collected by questionnaire. This study used continuous data scale. The data was transformed into dichotomous. Code 0=low value of perceived severity 1=high value of perceived severity.

Perceived Benefit was the individual's perceived conviction on the benefits in conducting caries preventive behavior. The data were collected by questionnaire. This

study used continuous data scale. The data was transformed into. Code 0 for low and 1 for high.

Perceived Barrier was the individual's conviction about barriers in changing caries preventive behavior. The data were collected by questionnaire. This study used continuous data scale. The data was transformed into. Code 0=low value of perceived barrier 1=high value of perceived barrier.

Caries Preventive Behavior was actions conducted by individuals to prevent caries. The data were collected by questionnaire. Code 0=poor value of caries preventive behavior 1=good value of caries preventive behavior.

5. Data Analysis

The characteristics of the sample of the data related to caries preventive behavior, perceived susceptibility, perceived severity,

Table 1. Sample characteristic of continuous data

Variable	N	Mean	SD	Min.	Max.
Caries preventive behavior	200	18.62	1.54	15	22
Perceived susceptibility	200	12.10	1.64	10	18
Perceived severity	200	14.01	1.57	12	20
Perceived benefit	200	16.26	1.38	13	20
Perceived barrier	200	10.87	1.62	8	14

Table 2. Sample characteristic of categorical data

Characteristic	n	Percentage
Caries Preventive Behavior		
Poor	38	19
Good	162	81
Perceived Susceptibility		
Low	98	49
High	102	51
Perceived Severity		
Low	111	55.5
High	89	44.5
Perceived Benefit		
Low	61	30.5
High	139	69.5
Perceived Barrier		
Low	39	19.5
High	161	80.5

Table 2 shows that 162 study subjects (81%) had good caries preventive behavior, 102

perceived benefit, and perceived barrier were explained in n, mean, SD, minimum, maximum, and %. Bivariate analysis was conducted by using the Chi-square test. Multivariate analysis was conducted by multilevel multiple logistic regression.

6. Study Ethics

This study was conducted based on the study ethics which consisted of informed consent form, anonymity, confidentiality, and ethical clearance. Ethical clearance was obtained from the Health Research Ethics Committee of Dr. Moewardi Hospital, Surakarta, Indonesia, No: 972/VIII/HREC/-2019.

RESULTS

1. Sample Characteristics

Sample characteristics was described in Table 1 and Table 2.

study subjects (51%) had high perceived susceptibility, 111 study subjects (55.5%)

had low perceived severity, 139 study subjects (69.5%) had high perceived benefit, and 161 study subjects (80.5%) had high perceived barrier.

2. Bivariate Analysis

The bivariate analysis in this study used Chi Square analysis. Table 3 shows the effect of the theory of Health Belief Model on caries preventive behavior. There was an effect of perceived susceptibility on caries preventive behavior in children. The study subjects with high perceived susceptibility had the possibility to take good caries preventive behavior by 2.03 times compared to low perceived susceptibility (OR= 2.03; 95% CI= 0.98 to 4.22; p=0.052).

There was an effect of perceived severity on caries preventive behavior in the primary school children, but the result was statistically non-significant. The study subjects with high perceived severity had

the possibility to take good caries preventive behavior by 0.86 times compared to low perceived severity (OR= 0.86; 95% CI= 0.42 to 1.76; p=0.693).

There was an effect of perceived benefit on caries preventive behavior in the primary school children, but the result was statistically non-significant. The study subjects with high perceived benefit had the possibility to take good caries preventive behavior by 1.06 times compared to low perceived benefit (OR= 1.06; 95%CI=0.49 to 2.28; p=0.872).

There was an effect of perceived barrier on caries preventive behavior in children. The study subjects with high perceived barrier had the possibility to take good caries preventive behavior by 2.3 times compared to low perceived severity (OR= 2.3; CI95%=1.03 to 5.13; p=0.037).

Table 3. The chi-square test of the effect of the health belief model theory on caries preventive behavior

Independent Variable	Caries Preventive Behavior				OR	CI 95%		p
	Good		Poor			Upper Limit	Lower Limit	
	n	%	n	%				
Perceived Susceptibility								
Low	74	45.6	14	36.8	2.03	4.22	0.98	0.052
High	88	54.4	24	63.2				
Perceived Severity								
Low	71	43.8	18	47.4	0.86	1.76	0.42	0.693
High	91	56.2	20	52.6				
Perceived Benefit								
Low	49	30.3	12	31.5	1.06	2.28	0.49	0.872
High	113	69.7	26	68.5				
Perceived Barrier								
Low	27	16.7	12	31.5	2.3	5.13	1.03	0.037
High	135	83.3	26	68.5				

3. Multivariate Analysis

The multivariate analysis in this study used multilevel multiple logistic regression method with Stata 13. Multivariate analysis

explained the effect of more than 1 independent variable on 1 dependent variable.

Table 4 shows that caries preventive behavior increased with perceived susceptibility (b=0.89; 95%CI=0.85 to 1.69; p=

0.030), perceived severity (b=1.59; 95%CI= 2.73 to 0.44; p=0.006), perceived benefit (b= 1.05; 95%CI=1.97 to 0.12; p=0.026), and perceived barrier (b=-1.54; 95%CI=- 2.84 to 0.25; p=0.019).

There was a contextual effect of primary school on caries preventive behavior based on the theory of Health Belief Model (ICC 7%) theory, but the effect was statistically low.

Table 4. The result of the multivariate analysis of the effect of health belief model theory on caries preventive behavior

Independent Variable	Regression Coefficient (b)	(95%) CI		P
		Upper Limit	Lower Limit	
Fixed Effect				
Perceived susceptibility (high)	0.89	1.69	0.85	0.030
Perceived severity (high)	1.59	2.73	0.44	0.006
Perceived benefit (high)	1.05	1.97	0.12	0.026
Perceived barrier (high)	-1.54	0.25	-2.84	0.019
Random Effect				
Primary School	0.24	5.24	0.011	
Variation (Constant)				
n observation = 200				
Log likelihood = -83.611				
LR test vs logistic regression, p =0.217				
Intra Class Corelation (ICC) = 7%				

DISCUSSION

1. Perceived susceptibility on caries preventive behavior among primary school children

The result showed that there was an effect of perceived susceptibility on caries preventive behavior in primary school children. The primary school children who had high perceived susceptibility had a logodd of 0.89 units higher to do caries preventive behavior than low perceived susceptibility (b=0.89; 95%CI=0.85 to 1.69; p=0.030).

The primary school children who realized that they were susceptible or at risk of a disease would make an effort to prevent caries by taking caries preventive behavior. Based on the theory of Health Belief Model developed by Rusenstock (1994), the assumption that a person was transmitted to a disease would make themselves aware of taking preventive action and protection. A person who considers himself susceptible

to a condition or serious problem will take action to protect themselves (Murti, 2018).

Based on a study conducted by Puri (2016), there was an effect between perceived susceptibility and the completeness of immunization status. Mothers who felt that their children were vulnerable to a disease and realize that it could be prevented by immunization would take precaution with vaccines and vice versa.

Based on another study conducted by Wakhida (2017), there was an effect of perceived susceptibility on the use of VCT (Voluntary Counseling and Testing). Pregnant women with high perceived susceptibility about HIV/AIDS would increase the use of VCT.

Based on a study conducted by Solhi (2017), there was an effect of perceived susceptibility on dental and oral health education for 12-year-old children.

Based on a study conducted by Indrian (2014), there was a correlation

between perceived susceptibility and health services in the theory of Health Belief Model. The conclusion of Indrian's study is if the susceptibility of a disease increases, the health services in the theory of Health Belief Model will increase.

2. Perceived severity on caries preventive behavior among primary school children

There was an effect of perceived severity on caries preventive behavior in the primary school children. The primary school children who had high perceived severity had a logodd of 1.59 units higher to do caries preventive behavior than low perceived severity ($b=1.59$; 95% CI= 2.73 to 0.44; $p=0.006$).

The result of this study is in line with a study conducted by Wigati (2016) that there was an effect between perceived severity and the implementation of an IVA test (visual inspection with acetic acid). The more severe an illness, the more someone will try to take preventative action.

Based on another study conducted by Solhi (2017), there was an effect of perceived severity on dental and oral health education for 12-year-old children.

The result of this study is relevant to the theory of Health Belief Model. The perceived severity/seriousness determines whether a someone will take preventive behavior or not. Perceived seriousness/severity are often come from media information, knowledge, or a person's belief that she/he will get into trouble due to an illness that will complicate her/his life (Hooley, 2012).

3. Perceived benefit on caries preventive behavior among primary school children

There was an effect of perceived benefit on caries preventive behavior in the primary school children. The primary school children who had high perceived benefit had a

logodd of 10.5 units higher to do caries preventive behavior than low perceived benefit ($b=1.05$; 95%CI= 1.97 to 0.12; $p=0.026$).

The result of this study is in line with a study conducted by Wakhida (2016) that there was an effect between perceived benefit and the use of VCT. Pregnant women who had high perceived benefit of HIV/AIDS would use the VCT test.

Based on a study conducted by Ningrum (2016), there was an effect between perceived benefit and cadre performance on tuberculosis case control. Cadres who had high perceived benefit would do the job in controlling tuberculosis cases better than cadres who had low perceived benefit.

Based on another study conducted by Solhi (2017), there was an effect of perceived benefit on dental and oral health education for 12-year-old children.

Based on a study conducted by Wigati (2016), there was an effect of perceived benefit and the implementation of an IVA test. Women who increasingly feel the perceived benefit of an action to avoid a disease will prefer to do the action.

The theory of Health Belief Model, Rusenstock (1982) states that individuals that believe a behavior is beneficial to themselves and the environment will prefer to do the behavior. However, if the benefit obtained is not appropriate, the behavior will not occur. The example of perceived benefit for primary school children is taking caries preventive behavior in order to prevent caries. This study showed that the primary school age children would take caries preventive behavior if it was beneficial to prevent dental caries and vice versa.

4. Perceived barrier on caries preventive behavior among primary school children

There was an effect of perceived barrier on caries preventive behavior in the primary school children. The primary school child-

ren who had high perceived barrier had a logodds of 1.54 units lower to do caries preventive behavior than high perceived barrier ($b=-1.54$; 95%CI=-2.84 to 0.25; $p=0.019$).

The result of this study is in line with a study conducted by Puri (2016) that there was an effect between perceived barrier and the completeness of immunization status. Mothers who had perceived barrier in immunizing their babies would not choose to take precaution by immunizing babies and vice versa.

Based on a study conducted by Solhi (2017), there was an effect of perceived severity on dental and oral health education for 12-year-old children.

Based on a study conducted by Wigati (2016), there was an effect of perceived barrier on the implementation of IVA test. Women who had high perceived barrier in conducting a behavior will reduce the possibility to take an IVA tests.

Based on a study conducted by Sutrisni (2016), there was an effect of perceived barrier on the willingness to take an HIV test. Pregnant women who felt barriers in carrying out HIV test would not choose to take precaution by doing HIV test and vice versa.

Based on a study by Heaton (2018), there was an effect of Health Belief Model on perceived barrier. 72% of mothers reported that they had one or more barriers to take oral health care, such as access. There was a significant correlation between barriers to do oral health care and low score of oral health behavior.

The result of this study is in accordance with the theory of Health Belief Model (Rusenstock, 1982) in Ningrum (2016), that precaution of a disease or seeking treatment was affected by perceived barrier that arise in conducting an action. General barriers experienced by a person in deter-

mining health actions or utilizing health services are dominated by personal constraints. Perceived barrier is an element that determine whether a behavior change occurs or not.

5. The contextual effect of school

Based on the result of the data analysis, the result of ICC=7%. The variation of caries preventive behavior by 7% was determined by variables at the primary school level. This rate was smaller than the standard size of rule of thumb by 8-10%. Therefore, there was a contextual effect shown from the multilevel analysis, but the result was statistically low.

The result of the study is in line with a study by Anagnostopoulos (2011), that stronger self-efficacy and greater perceived severity of oral disease that were associated with an increase in the frequency of tooth brushing as indicated by the total number of decayed, missing, and dental caries decreased. The contextual value of health belief model of toothbrushing behavior among parents of the students in primary school was low.

Based on a study conducted by Najarkolaei (2016), there was a correlation between knowledge, perceived barrier, cues to action, and maternal education and dental and oral health behavior, but the contextual value of integrated services post was low.

Based on another study conducted by Solhi (2019), there was a predictor correlation to the oral health behavior in students in Iran based on a health belief model, but the contextual value of the school was low.

AUTHOR CONTRIBUTION

Dewi Mustika Ratih was the main who played a role in carrying out the study, collecting data, formulating the articles of the study, and processing the data. Yulia

Lanti Retno Dewi played a role in preparing the background and analyzing the data of the study. Bhisma Murti played a role in formulating the theoretical framework and discussing the study.

FUNDING AND SPONSORSHIP

This study used personal funds from the main researcher.

CONFLICT OF INTEREST

The study did not have any conflict of interest.

ACKNOWLEDGEMENT

We give the best gratitude to the headmaster of the Head of Education Office, Klaten Regency. We also give the gratitude to all primary students who have been willing and cooperative to become the subjects of the study.

REFERENCE

- Anagnostopoulos F (2011). Self-efficacy and oral hygiene beliefs about toothbrushing in dental patients: a model-guided study. *J Behav Med.* 37(4). 132-9. doi: 10.1080.08964289.2011.636770
- Goodarzi A (2019). Predicting oral health behaviors among Iran students by using health belief model. *J Edu Health Promot.* 8(10): 19. doi:10.4103/jehp.-jehp_10_18
- Heaton B (2018). Oral health beliefs, knowledge, and behaviors in Northern California American Indian and Alaska native mother regarding early childhood caries. *J Public Health Dent.* 77(4): 350-359.doi:10.1111/jhpd.12217.
- Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N (2012). Parental influence and the development of dental caries in children aged 0-6 years: a systematic review of the literature. *J Dent.* 40(11):873-885.http://doi.org/10/1016/j.jdent.2012.07.013.
- Indrian PT, Tamtomo D, Wujoso H (2014). Hubungan persepsi kerentanan dan keseriusan penyakit dengan pelayanan kesehatan pada health belief model. Universitas Sebelas Maret Surakarta. Retrieved from <https://digilib.uns.ac.id/dokumen/download/36927/MTA2NDMx/Hubungan-Persepsi-Kerentanan-Penyakit-Dan-Keseriusan-Penyakit-Dengan-Pelayanan-Kesehatan-Pada-Health-Belief-Model-COVER.pdf>.
- Koizer, Erb, Berman, Snyder (2011). Buku ajar fundamental keperawatan: konsep, proses dan praktik (7 ed., Vol 1). Jakarta: EGC
- Murti B (2018). Prinsip dan metode riset epidemiologi edisi keempat. Karanganyar: Bintang Fajar Offset.
- Najarkolaei R (2016). Predictors of oral health behaviors in female students: an application of the health belief model. *Iran Red Crescent Med J.* 18(11):24-47.doi:10.5812/ircmj.24747.
- Ningrum DNS, Murti B, Dharmawan R (2016). Path analisis hubungan pendidikan dan konstruk health belief model dengan kinerja kader pada pengendalian kasus tuberkulosis di puskesmas baki kabupaten Sukoharjo. *J Health Policy and Manage.* 1(1):38-43.doi: 10.26911/thejhpm.2016.01.01.06.
- Puri YE, Murti B, Demartoto A (2016). Pengaruh persepsi ibu tentang imunisasi ditinjau dengan health belief model terhadap kelengkapan status imunisasi. *J Health Promot and Behav.* 1(3):211-222.doi:10.26911/thejhp.2016.01.03.08.
- Putri HH, Herijuliyanti E, dan Nurjannah N (2012). Ilmu Pencegahan Penyakit

- Jaringan Keras dan Jaringan Pendukung Gigi. Jakarta. EGC.
- Solhi MD, Shojaei Zadeh, B Seraj, S Faghieh Zadeh (2017). The application of the health belief model in oral health education. *Iran J of Public Health*. 39-(4): 114-119.[doi:10.2356.23113044](https://doi.org/10.2356.23113044).
- Sulaeman S (2016). Model dan teori perilaku kesehatan konsep dan aplikasi. Surakarta: UNS Press
- Sutrisni (2016). Health belief model dan analisis jalur tentang faktor yang mempengaruhi kesediaan tes human immunodeficiency Virus pada ibu hamil di kota kediri. Universitas Sebelas Maret Surakarta. Retrieved from <https://eprints.uns.ac.id/29389/>.
- Wakhida SW, Dermatoto A (2016). Health belief model tentang faktor-faktor yang mempengaruhi penggunaan VCT pada ibu hamil di Puskesmas Kota Malang. Retrieved from <http://digilib.uns.ac.id/dokumen/detail/55785/Health-Belief-Model-Tentang-Faktor-Faktor-yang-Mempengaruhi-Penggunaan-VCT-pada-Ibu-Hamil-di-Puskesmas-Kota-Malang>.
- Wigati PW (2016). Analisis jalur dengan health belief model tentang penggunaan skrining inspeksi visual asam asetat untuk deteksi dini Kanker serviks pada wanita usia subur di kota kediri. Tesis. Universitas Sebelas Maret Surakarta. Retrieved from <https://eprints.uns.ac.id/28793/>
- World Health Organization (2017). caries. Health topics. Retrieved from <https://www.who.int/topics/caries/en/>.