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# Path Analysis: Health Belief Model Application on Predicting Oral Hygiene Behavior of Junior High School Students in Surakarta, Central Java, Indonesia

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## ABSTRACT

**Background:** The high prevalence of orodental diseases, accompanied by low prevalence of appropriate behavior in maintaining orodental health, shows the urgency of health institutions to understand the determinants influencing such behaviors in Indonesia. The aims of this study was to analyze the effect of applying the health belief model on orodental health behavior among middle school students in Surakarta.
**Subjects and Method:** This study was a cross-sectional observational analytical quantitative study, which was conducted in 14 public Junior High Schools in Surakarta, Central Java, Indonesia from January to March 2025. The independent variables were perceived susceptibility, perceived severity, perceived benefit, perceived barrier, self-efficacy, and cues to action. Orodental health behavior acts as the dependent variable. Subjects were determined using a multistage random sampling method with a total of 210 students. The data were collected through a researcher-made questionnaire, which included questions about demographic characteristics and the six HBM constructs. Data analysis was conducted using path analysis by StataMP 13.
**Results:** Orodental health behavior in middle school students was directly influenced by perceived benefit (OR= 0.36; CI 95%= 0.26 to 0.45; p<0.001), perceived susceptibility (OR= 0.47; CI 95%= 0.38 to 0.55; p<0.001), and self-efficacy (OR= 0.20; CI 95%= 0.10 to 0.30; p<0.001). Orodental health behavior was also indirectly influenced by perceived susceptibility and cues-to-action.
**Conclusion:** Perceived benefit, perceived susceptibility, and self-efficacy significantly improved orodental health behavior in students.

**Keywords:** oral behavior, health belief, path analysis

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## BACKGROUND

The oral cavity is the initial part of the digestive system, which is composed of soft and hard tissue. It is divided into two areas by the teeth and the alveolar bone, i.e., the vestibule and the cavum oris propria (Ozturk et al., 2017). The oral cavity is home to more than 700 species of bacteria and a number of viruses, archaea, fungi,

and protozoa (Nascimento, 2019). Poor oral hygiene can cause infection and inflammation, which are certainly very dangerous (Agustina and Sihotang, 2023).

The orodental health is a condition in which the oral cavity and its anatomical structures are normal and disease-free (Baiju et al., 2017). It is an integral part of the body's overall health, as its condition can significantly impact the well-being and the quality of life for the individual concerned. Difficulty in chewing food due to cavities, tooth loss, calculus buildup, tumors, and various other orodental diseases is known to cause weight loss, leading to changes in individuals' attitudes and performances (Spanemberg et al., 2019).

Maintaining orodental health can be done by toothbrushing, using dental floss, and routine dental checkups. Lack of awareness and care on the orodental health will not only cause oral diseases, but may also systemically affect the body (Spanemberg et al., 2019; Sumita et al., 2022). Pathogens that play a big role in caries and periodontitis are associated with an increased risk of Non-Communicable Diseases (NCDs), such as hypertension, stroke, diabetes mellitus, obesity, adverse pregnancy outcomes, chronic kidney disease, Alzheimer's disease, Von Willebrand disease, and Chediak-Higashi disease (Dörfer et al., 2017).

According to a national survey, the prevalence of orodental problems in Indonesia has continued to increase, namely from 23.5% in 2007 to 25.9% in 2013 and has significantly increased to 57.6% in 2018. The latest survey in 2023 showed a decrease in the number, but still above 50% of the total population. It was also found that 55.6% of Indonesians aged 10-14 years had experienced at least one problem in their oral cavity. A total of 73.4% had experienced caries, and only 2.1% had proper toothbrushing (Riskesdas, 2018, 2013, 2007; SKI, 2023).

A study by Rosalien et al. (2018) found that only 3 out of 478 middle school students aged 12 years old had normal periodontal conditions. The study also found that 99% students experienced gingival bleeding and 84% students experienced dental calculus. The high prevalence of orodental diseases, accompanied by low prevalence of appropriate behavior in maintaining orodental health, shows the urgency of health institutions to understand the determinants influencing such behaviors in Indonesia.

Numerous health promotion models have been developed by health experts to comprehend health behavior. The Health Belief Model (HBM), which was introduced in 1966 by Irwin M. Rosenstock, was proposed to explain and predict health behavior based on individuals' beliefs or perceptions. There are six constructs in this model, including: 1) perceived susceptibility, 2)perceived severity, 3) perceived benefit, 4) perceived barrier, 5) cues to action, and 6) self-efficacy (Sumita et al., 2022; Xiang et al., 2020a).

According to HBM, belief and attitude may influence individuals' health behavior. Individuals will engage in a health behavior if their perceived severity, susceptibility, and benefit outweigh their perceived barrier. On the other hand, self-efficacy and cues-to-action are related to self-confidence, abilities, and socioeconomic factors. Demographic and psychological characteristics may also directly influence individuals' perceptions regarding the adoption of the behavior (Xiang et al., 2020b). By understanding these beliefs and attitudes, specific health promotion programs can be implemented to address health issues and determine the right solutions.

Several studies have examined related topics regarding HBM and its effect on health behavior. A study in 2022 found a significant decrease in papillary bleeding index and decayed, missing, filled teeth score among students aged 6 – 12 years old in Tehran, Iran. Those were the indicators used to determine oral health status (Sanaeinasab et al., 2022). A study conducted by Kusumawardhani et al. (2020) showed significant relationships between HBM constructs and orodental health behavior among primary students in Ponorogo, Indonesia. Increased orodental health behavior was found along with increased perceived susceptibility, severity, benefit, cues to action, and self-efficacy. On the other hand, a decrease in perceived barrier was also found in the study. Based on the explanation above, the authors are interested in conducting this study to analyze the determinants that affect the orodental health behavior based on the implementation of the HBM among middle school students in Surakarta, Indonesia.

## SUBJECTS AND METHOD

### 1. Study Design

The design of the study was a quantitative observational study with a cross-sectional approach. The study was conducted from January to March 2025 in 14 public Junior High School in Surakarta, Central Java, Indonesia.

### 2. Population and Sample

The population in this study was 19,007 public middle school students in Surakarta. A total of 210 students were selected as the subjects using a multistage random sampling technique. Inclusion criteria were students who gave consent to participate, were currently in grade VIII, and were actively studying in a public middle school in the area of Surakarta.

Subject selection was determined through several stages. The first stage was done by dividing the population into several clusters. There are 27 schools in Surakarta, half of which were then selected through simple random sampling. The second stage was done to divide the 14 schools into several clusters to determine the class that would be used for data collection, with each class being taken as many as 15 subjects randomly. This was based on Dash and Paul (2021) which stated that the minimum sample recommended in multivariate analysis is 200 subjects.

### 3. Study Variables

The independent variable of the study consists of perceived susceptibility, perceived severity, perceived benefit, perceived barrier, cues to action, and self-efficacy. On the other hand, the dependent variable was orodental health behavior.

### 4. Operational Definition of Variables

**Perceived Susceptibility:** The individual's beliefs about the risk likelihood of developing oral diseases.

**Perceived Severity:** The individual's beliefs regarding the degree of injury and its fatal outcome of having oral diseases.

**Perceived Benefit:** The individual's beliefs about the positive impacts of implementing orodental health behavior.

**Perceived Barrier:** The individual's beliefs related to the negative impacts and obstacles of implementing orodental health behavior.

**Self-efficacy:** The belief in one's ability to adopt orodental health behavior.

**Cues to Action:** The subjects, objects, or events that influence and act as stimuli for individuals to adopt orodental health behavior.

**Orodental Health Behavior:** The acts of maintaining orodental health, which can be done mechanically, chemically, or by monitoring diet.

**5. Study Instruments**

Data on HBM and orodental health behavior were collected by directly distributing researcher-made questionnaires to the subjects. The questionnaire contained several questions about respondent characteristics, HBM constructs, and orodental health behavior. Validity and reliability tests were conducted on 30 students. All item-total correlations showed a value of >0.20 and Cronbach's Alpha showed a value of ≥0.60; therefore, all questions were considered reliable .

**6. Data analysis**

The data were first analyzed using descriptive statistical methods to describe the characteristics of the subjects and to present the frequency distribution of both independent and dependent variables. Bivariate analysis was then used to determine the relationship between the six constructs of HBM and orodental health behavior. Path analysis was done to analyze the structural relationships between the independent variables toward the dependent variable through the intervening variable. This multivariate analysis allows researchers to understand the interaction of every variable and identify direct, indirect, and total effects of the independent variable.

**7. Research Ethics**

All respondents participated voluntarily without coercion from any party and had filled in the informed consents needed to protect the anonymity and confidentiality of the participants. The research ethical clearance approval letter was obtained from the Health Research Ethics Committee at Dr. Moewardi Hospital, Surakarta, Indonesia, No. 2,490/X/HREC/2024, on October 24, 2024.

## RESULTS

**1. Sample Characteristics**

A total of 210 subjects with different characteristics of age, gender, parental occupation, and parental education level had participated in this study (Table 1). This analysis was also done to describe study variables, as it was presented in Table 2.

**Table 1. Distribution of subjects by age, gender, and parental occupation and education level**

| Variables | Category | Frequency | Percentage |
|---|---|---|---|
| **Age** | 13 years old | 63 | 30% |
| | 14 years old | 127 | 60.4% |
| | 15 years old | 17 | 8.1% |
| | 16 years old | 3 | 1.4% |
| **Gender** | Male | 121 | 57.6% |
| | Female | 89 | 42.3% |
| **Father's occupation** | Non-employed | 11 | 5.2% |
| | Health professionals | 2 | 0.9% |
| | Retired | 7 | 3.3% |
| | Others | 190 | 90.4% |
| **Father's education** | No education | 0 | 0% |
| | Primary school | 13 | 6.1% |
| | Middle school | 43 | 20.4% |
| | High school | 98 | 46.6% |
| | Undergraduate | 48 | 22.8% |
| | Postgraduate (master's degree) | 7 | 3.3% |
| | Postgraduate (doctoral degree) | 1 | 0.4% |
| **Mother's** | Non-employed | 105 | 50% |

| Variables | Category | Frequency | Percentage |
|---|---|---|---|
| **occupation** | Health professionals | 5 | 2.3% |
| | Retired | 2 | 0.9% |
| | Others | 98 | 46.6% |
| **Mother's education** | No education | 1 | 0.48% |
| | Primary school | 17 | 8.1% |
| | Middle school | 28 | 13.3% |
| | High school | 114 | 54.2% |
| | Undergraduate | 39 | 18.57% |
| | Postgraduate (master's degree) | 11 | 5.24% |
| | Postgraduate (doctoral degree) | 0 | 0% |

Table 2 showed that 121 participants were male (57.6%) and 89 participants were female (42.3%). Most participants were found to be 14 years old (60.4%) and 13 years old (30%). Only 17 participants (8.1%) and 3 participants (1.4%) were found to be 15 and 16 years old. Most participants had a father whose main occupation was not a health professional (90.4%) and a housewife mother (50%). It was also shown that the majority of the participants' fathers (46.6%) and mothers (54.2%) were only high school graduates.

**Table 2. Distribution of subjects based on HBM and orodental health behavior**

| Variables | Frequency (N) | Percentage (%) |
|---|---|---|
| **Perceived susceptibility** | | |
| Low | 51 | 24.2 |
| High | 159 | 75.7 |
| **Perceived severity** | | |
| Low | 12 | 5.7 |
| High | 198 | 94.2 |
| **Perceived benefit** | | |
| Low | 16 | 7.6 |
| High | 194 | 92.3 |
| **Perceived barrier** | | |
| Low | 197 | 93.8 |
| High | 13 | 6.1 |
| **Self-efficacy** | | |
| Low | 42 | 20 |
| High | 168 | 80 |
| **Cues to action** | | |
| Low | 51 | 24.2 |
| High | 159 | 75.7 |
| **Orodental health behavior** | | |
| Poor | 82 | 39 |
| Good | 128 | 60.9 |

Based on Table 3, it was found that most participants had high perceived threat, namely 75.7% for perceived susceptibility and 94.2% for perceived severity. It was also found that 194 participants (92.3%) had a high perceived benefit, while 197 participants (93.8%) had a low perceived barrier. The findings also showed

that 168 participants (80%) and 159 participants (75.7%) had high self-efficacy and cues to action, respectively. Most participants (60.9%) were also found to have good orodental health behavior.

**2. Bivariate Analysis**

The results of the analysis in Table 3 showed that perceived susceptibility (OR= 16.5; 95% CI= 7.16 to 38.18; p < 0.001), self-efficacy (OR= 4.22; 95% CI= 2.05 to 8.66; p < 0.001), and cues to action (OR= 2.63; 95% CI= 1.38 to 5.02; p= 0.003) had positive relationships and were statistically significant towards orodental health behavior. On the other hand, perceived severity (OR= 0.13; 95% CI= 0.01 to 1.03; p= 0.054), perceived benefit (OR= 1.62; 95% CI = 0.58 to 4.50; p = 0.354), and perceived barrier (OR = 0.37; 95% CI= 0.11 to 1.19; p= 0.097) also had positive effects towards orodental health behavior, but were statistically insignificant.

**Table 3. Determinants of orodental health behavior**

| Variables | Orodental Health Behavior | | | | OR | p |
|---|---|---|---|---|---|---|
| | Poor | | Good | | | |
| | N | % | N | % | | |
| **Perceived susceptibility** | | | | | | |
| Low | 43 | 20.4 | 8 | 3.8 | 16.5 | < 0.001 |
| High | 39 | 18.5 | 120 | 57.1 | | |
| **Perceived severity** | | | | | | |
| Low | 1 | 0.4 | 11 | 5.2 | 0.13 | 0.054 |
| High | 81 | 38.5 | 117 | 55.7 | | |
| **Perceived benefit** | | | | | | |
| Low | 8 | 3.8 | 8 | 3.8 | 1.62 | 0.354 |
| High | 74 | 35.2 | 120 | 57.1 | | |
| **Perceived barrier** | | | | | | |
| Low | 74 | 35.2 | 123 | 58.5 | 0.37 | 0.097 |
| High | 8 | 3.8 | 5 | 2.38 | | |
| **Self-efficacy** | | | | | | |
| Low | 28 | 13.3 | 14 | 6.6 | 4.22 | < 0.001 |
| High | 54 | 25.7 | 114 | 54.2 | | |
| **Cues to action** | | | | | | |
| Low | 29 | 13.8 | 22 | 10.4 | 2.63 | 0.003 |
| High | 53 | 25.2 | 106 | 50.4 | | |

**3. Multivariate analysis**

In this study, the multivariate analysis conducted was path analysis. Path analysis is a statistical method used to analyze structural relationships between the independent variables towards the dependent variable through the intervening variable, as it was presented in Figure 1. This analysis allows researchers to understand the interaction of every variable and identify direct, indirect, and total effects of the independent variable. The degree of freedom (df) was calculated and showed a value of 5, which meant that it was overidentified and the path analysis could be performed. The structural model shown in Figure 1 demonstrated a good overall fit (Goodness of Fit: Chi-square p = 0.695 > 0.05. RMSEA < 0.001 < 0.08. CFI = 1.00 > 0.90. TLI = 1.00 > 0.90. SRMR = 0.013 < 0.05). Table 4 showed that orodental health behavior was influenced by perceived

susceptibility, perceived benefit, self-efficacy, and cues to action. A significant effect of perceived benefit towards orodental health behavior was found in this study. Students with high perceived benefit would increase the logodd of orodental health behavior by 0.36 units higher than students with low perceived benefit (b = 0.36; 95% CI = 0.26 to 0.45; p<0.001).

There was also a significant influence of perceived susceptibility towards orodental health behavior. Students with high perceived susceptibility would increase the logodd of orodental health behavior by 0.47 units higher than students with low perceived susceptibility (b = 0.47; 95% CI = 0.38 to 0.55; p<0.001). Students with high self-efficacy would increase the logodd of orodental health behavior by 0.20 units higher than those with low self-efficacy (b = 0.20; 95% CI = 0.10 to 0.30; p<0.001).

Table 4 also showed that every one-unit increase in perceived susceptibility would increase perceived benefit by 0.17 units (b = 0.17; 95% CI = 0.04 to 0.30; p = 0.009). Every one-unit increase in cues to action would also increase self-efficacy by 0.81 units (b = 0.81; 95% CI = 0.77 to 0.85; p<0.001).

**Table 4. The results of path analysis on HBM towards orodental health behavior among Junior High School students in Surakarta**

| Dependent Variables | | Independent Variables | b | 95% CI | | p |
|---|---|---|---|---|---|---|
| | | | | Lower Limit | Upper Limit | |
| **Direct effect** | | | | | | |
| Orodental health | ← | Perceived benefit | 0.36 | 0.26 | 0.45 | <0.001 |
| behavior | ← | Perceived susceptibility | 0.47 | 0.38 | 0.55 | <0.001 |
| | ← | Self-efficacy | 0.20 | 0.10 | 0.30 | <0.001 |
| **Indirect effect** | | | | | | |
| Perceived benefit | ← | Perceived susceptibility | 0.17 | 0.04 | 0.30 | 0.009 |
| Self-efficacy | ← | Cues to action | 0.81 | 0.77 | 0.85 | <0.001 |
| **Model Fit** | | | | | | |
| p | = | 0.695 | | | | |
| RMSEA | = | 0.000 | | | | |
| CFI | = | 1.00 | | | | |
| TLI | = | 1.00 | | | | |
| SRMR | = | 0.013 | | | | |
| N observation= 210 | | | | | | |
| Log likelihood= -1503.14 | | | | | | |

## DISCUSSION

### 1. The direct influence of perceived benefit towards orodental health behavior

This study found a direct influence between perceived benefit and orodental health behavior. The results showed that students with high perceived benefit would increase orodental health behavior more than students with low perceived benefit. Perceived benefit is one's belief about the benefits they will obtain once they adopt a certain health behavior to reduce the risk of experiencing a disease (Sumita et al., 2022).

According to the HBM theory, perceived benefit plays a major role in the actions of individuals. They tend to engage in behaviors that benefit them. For example, someone who believes that reducing sugar consumption will prevent cavities is more likely to comply than someone who does not believe in the benefit of avoiding

sugar consumption (Sumita et al., 2022; Yusuf et al., 2024).

A study by Yusuf et al. (2024) found that individuals with high perceived benefit tend to adopt orodental health behavior compared to those with low perceived benefit. This might be because a health behavior was considered beneficial to one's health, thus it influenced awareness and created intentions in maintaining health, triggering individuals to engage in that behavior (Mohammadkhah et al., 2022).

**2. The direct influence of perceived susceptibility towards orodental health behavior**

The results of this study showed that there was a direct influence between perceived susceptibility and orodental health behavior. Students with high perceived susceptibility would increase their oral health behavior more than students with low perceived susceptibility. Perceived susceptibility is one's belief in contracting a disease (Sukhabogi et al., 2024).

In this study, perceived susceptibility is defined as students' perceptions about their risk level of adopting a disease due to not carrying out orodental health behavior. If one feels that they are at risk of contracting a disease that will bring harm to their life, it would raise one's awareness of taking preventive and protective measures (Ratih et al., 2019). Those who consider themselves susceptible to harmful conditions will try to protect themselves (Murti, 2018).

The theory is in line with a previous study conducted by Ratih et al. (2019), which proved that students who believed that they were at risk of experiencing caries would tend to engage in orodental health behavior in order to prevent caries. According to the HBM theory, perceived susceptibility and severity are caused by emotions of threats. The motivation to protect themselves from harmful conditions will emerge and move individuals to engage in health behavior (Xiang et al., 2020a).

**3. The direct influence of self-efficacy on orodental health behavior**

This study showed a direct influence between self-efficacy and orodental health behavior. The results indicated that students who had high self-efficacy would improve orodental health behavior more than those with low self-efficacy. Self-efficacy is one's belief in their ability to maintain health or one's outcome expectation in improving health (Thiemann et al., 2024).

According to Nasir and Suliman (2022), self-efficacy is a major predictor of orodental health behavior. Adopting a healthy behavior begins with self-confidence and skills. The skills are needed to carry out and maintain a certain behavior (McNeil, 2023). Higher self-efficacy may increase awareness of behavior and suppress existing obstacles so that individuals are moved to engage in health action (Jones et al., 2015). A previous study by Liu et al. (2024) had found that high self-efficacy increased toothbrushing action by two times daily among children in China.

**4. The indirect influence of perceived susceptibility towards orodental health behavior through perceived benefit**

In this study, an indirect positive relationship was found between perceived susceptibility and orodental health behavior through perceived benefit. The results showed that students with high perceived susceptibility would increase perceived benefit, which influenced the increase in orodental health behavior.

Perceived susceptibility is one's perception and understanding regarding the risk level of suffering from a disease caused by the actions taken. The higher the per-

ceived susceptibility, the greater the tendency of an individual to take preventive action against health problems (Flora et al., 2024). Compliance in adopting health behavior depends on the perception of risk and benefit of that certain behavior (Thiemann et al., 2024).

Preventive action that is taken to avoid a disease is known to be influenced by perceived susceptibility and benefit. A person will take preventive measures to control health problems when they feel at risk and believe in the benefits of the recommended methods. The feeling of vulnerability will trigger individuals to protect themselves by increasing their understanding of the positive impacts of a behavior. If one believes that a certain action will reduce the possibility of experiencing a health problem, it would trigger them to engage in that behavior (Fini et al., 2023).

**5. The indirect effect of cues to action towards orodental health behavior through self-efficacy**

An indirect positive relationship between cues to action and orodental health behavior through self-efficacy was found in this study. The results showed that students with high cues to action would increase self-efficacy, increasing orodental health behavior more than students with low cues to action.

This construct plays a big role for individuals to change their awareness and behavior in maintaining orodental health. The stimulus can come internally (direct experience of disease symptoms) or externally (participation in health promotion programs, exposure to disease information, and support from relatives) (Jones et al., 2015). These factors will drive individuals to engage in health behavior.

The belief in carrying out a certain action is not only influenced externally, but also comes from one's belief and ability (Setiari and Sulistyowati, 2017, as cited in Yusuf et al., 2024). Self-efficacy refers to one's belief in engaging in health behavior. A study by Ashoori et al. (2020) found that self-efficacy and cues to action promote students' oral health behaviors. Several previous studies also believed that parental factors, i.e., academic level and income, play a role in self-efficacy. Social influences and environmental factors, which are considered to be parts of cues to action, may affect a person's confidence in changing behavior (Gong and Sheng, 2022).

Based on the results of this study, it could be concluded that orodental health behavior in middle school students was directly influenced by perceived benefit, perceived susceptibility, and self-efficacy. This study also found that orodental health behavior was indirectly influenced by perceived susceptibility through perceived benefit and cues to action through self-efficacy. Therefore, the results of this study are in accordance with the HBM theory.

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## CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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