Vol. 8, No. 1, April 2026, pp 14-26
https://doi.org/10.36590/jika.v8i1.1924
http://salnesia.id/index.php/jika
jika@salnesia.id, p-ISSN: 2337-9847, e-ISSN: 2686-2883
Penerbit: Sarana Ilmu Indonesia (salnesia)

RESEARCH ARTICLES

# *Pendidikan Kesehatan Berbasis Health Belief Model tentang Gangguan Neurologis Pasca Stroke yang Berdampak pada Kesehatan Mulut: Studi Kuasi-Eksperimental*

# Health Belief Model–Based Education on Post-Stroke Neurological Disorders Affecting Oral Health: A Quasi-Experimental Study

**Jenal Abidin[1*], Sepriana Urianti[1]**
[1]Program Studi Teknik Gigi, Poltekkes Kemenkes Tanjung Karang, Lampung, Indonesia

## Abstract

Stroke is no longer limited to the elderly but is increasingly found among younger populations. However, adolescents' knowledge and attitudes toward stroke remain low. Stroke can affect oral and facial tissues, disrupting essential daily functions such as eating, drinking, swallowing, and communication. This study aimed to examine the effect of Health Belief Model (HBM)–based health education on students' knowledge and attitudes regarding post-stroke neurological disorders affecting oral health. The study employed a quasi-experimental approach using a non-equivalent control group design among 64 first-year students of Dental Technology and Dental Health at Tanjung Karang Polytechnic. Participants were chosen through simple random sampling and then assigned to experimental and control groups. The study consisted of three stages: pre-test, intervention, and post-test. Knowledge was measured using 20 multiple-choice questions, while attitudes were assessed using 15 Likert-scale statements. Data were analysed using Paired t-test, *Wilcoxon signed-rank*, Independent t-test, and *Mann-Whitney* with SPSS version 26. The results showed significant improvements in both groups ($p < 0.05$), with greater gains in the experimental group for knowledge ($t = 24.334$ vs. 8.184) and attitudes ($t = 13.538$ vs. $Z = -4.944$). However, based on the Independent t-test and *Mann-Whitney* test, the experimental group showed significantly greater improvements than the control group ($p < 0.05$). HBM-based health education was more effective than conventional education in improving students' knowledge and attitudes regarding post-stroke neurological disorders affecting oral health. The HBM approach was recommended as an effective educational framework for health promotion in post-stroke oral health care.

**Keywords:** education, health belief model, stroke

**Article history :**

Submitted 12 January 2026
Accepted 30 April 2026
Published 30 April 2026

**PUBLISHED BY:**
Sarana Ilmu Indonesia (salnesia)
**Address:**
Jl. Dr. Ratulangi No. 75A, Baju Bodoa, Maros Baru, Kab. Maros, Provinsi Sulawesi Selatan, Indonesia

**Email:**
info@salnesia.id, jika@salnesia.id
**Phone:**
**+62 85255155883**

***Abstrak***

*Stroke tidak lagi hanya dialami oleh kelompok lanjut usia, tetapi semakin banyak ditemukan pada populasi usia muda. Namun, pengetahuan dan sikap remaja terhadap stroke masih tergolong rendah. Stroke dapat memengaruhi jaringan rongga mulut dan wajah sehingga mengganggu fungsi dasar sehari-hari, seperti makan, minum, menelan, dan berkomunikasi. Tujuan penelitian ini adalah untuk mengetahui pengaruh pendidikan kesehatan berbasis Health Belief Model (HBM) terhadap pengetahuan dan sikap mahasiswa mengenai gangguan neurologis pasca stroke yang memengaruhi kesehatan rongga mulut. Desain penelitian ini adalah kuasi-eksperimen dengan non-equivalent control group pada 64 mahasiswa tingkat pertama Program Studi Teknik Gigi dan Kesehatan Gigi di Politeknik Kesehatan Kementerian Kesehatan Tanjung Karang. Subjek dipilih dengan simple random sampling yang dibagi menjadi kelompok eksperimen dan kontrol. Penelitian dilaksanakan dengan tiga tahap, yaitu pre-test, intervensi, dan post-test. Instrumen pengetahuan terdiri atas 20 soal pilihan ganda, sedangkan sikap diukur menggunakan 15 pernyataan skala Likert. Analisis data dilakukan dengan uji Paired t-test, Wilcoxon Signed-Rank Test, Independent t-test, dan uji Mann-Whitney menggunakan SPSS versi 26. Hasil penelitian menunjukkan peningkatan yang signifikan pada kedua kelompok ($p < 0,05$), dengan peningkatan lebih besar pada kelompok eksperimen untuk pengetahuan ($t = 24,334$ vs. $8,184$) dan sikap ($t = 13,538$ vs. $Z = -4,944$). Kelompok eksperimen menunjukkan peningkatan yang secara signifikan lebih tinggi dibandingkan kelompok kontrol ($p < 0,05$) baik pengetahuan maupun sikap. Pendidikan kesehatan berbasis HBM lebih efektif dibandingkan metode konvensional dalam meningkatkan pengetahuan dan sikap mahasiswa. Pendekatan HBM direkomendasikan sebagai kerangka edukasi yang efektif dalam promosi kesehatan dan perawatan kesehatan rongga mulut pasca stroke.*

***Kata Kunci:*** *edukasi, health belief model, stroke*

*Correspondence Author:
Jenal Abidin, email: jenala010@gmail.com



**Highlight:**

- Both the experimental and control groups achieved a statistically significant increase in knowledge and attitude scores after the evaluation period ($p < 0.05$).
- Students in the experimental group, who received Health Belief Model (HBM)-based education, demonstrated substantially greater score gains in both knowledge ($t = 24.334$ vs. $8.184$) and attitude ($t = 13.538$vs. $Z = –4.944$) compared to the control group that received conventional lectures.
- Statistical analysis confirmed that the HBM-based intervention was significantly more effective than conventional methods ($p < 0.05$) at expanding students' comprehension and transforming attitudes regarding post-stroke neurological disorders affecting oral health.

## INTRODUCTION

Stroke is one of the leading causes of death and long-term disability globally. In 2019, there were about 12.2 million new stroke cases, with over 101 million individuals living with the condition (GBD 2019 Stroke Collaborators, 2021). Stroke is an acute neurological condition caused by vascular disorders, lasting 24 hours or more or

resulting in death, and is classified into ischemic (vessel blockage) and hemorrhagic (vessel rupture) types (Kemenkes, 2019; CDC, 2024; Fadli, 2023). In Indonesia, according to the 2023 Indonesian Health Survey, the prevalence of stroke among individuals aged 15 years and above was 8.3 per 1,000 population, and Lampung Province ranked 11th as the province with the highest prevalence of stroke (Kemenkes, 2023).

Stroke is not only a health problem for the elderly, but is also beginning to be found in younger people. A total of 8,680 young adults, aged 18 to 49 years, in Denmark, were identified as having had a stroke (Skajaa et al., 2021). In the Netherlands, the incidence of stroke among young adults increased by 23% over a ten-year period (Ekker et al., 2019). The findings indicate that adolescents have stroke risk factors similar to those of the elderly (Rachmawati et al., 2022). Research in Indonesia shows that stroke also affects individuals of productive age, not only the elderly (Dewi and Asman, 2021).

Stroke may result in irreversible brain injury, prolonged disability, or even fatal outcomes (CDC, 2024). As a result of this damage, neurological functions may be temporarily or permanently impaired, including post-stroke movement disorders related to dental and oral health, which manifest as hypokinetic or hyperkinetic motor disturbances (Tater and Pandey, 2021). Stroke significantly affects oral and facial tissues, impairing basic functions such as eating, swallowing, and communication, and increasing the risk of infection and dental caries, which in turn impacts nutrition, quality of life, and overall recovery (British Society of Gerodontology, 2010). Studies indicate that stroke patients experience orofacial motor disorders and dysphagia, resulting in inadequate oral hygiene and a higher risk of dental caries and periodontal disease (Schmalz et al., 2022).

Knowledge and attitudes regarding the neurological effects of stroke on oral health should be developed during adolescence, especially among future dental health practitioners, yet education and awareness in this area remain limited. A study conducted in the United States reported that most adolescents lack a comprehensive awareness of stroke (Umar et al., 2019). Another study involving 3,456 subjects showed that around 69.7% of subjects had low knowledge about stroke (Mubaraki et al., 2021). A study in Thailand shows that most subjects possess low to moderate awareness and tend to underestimate the risk of stroke (Wanichanon et al., 2024). Research results in Indonesia also stated that the majority of subjects did not know the basics about stroke (Handayani, 2019). Knowledge and attitudes toward stroke are essential, as studies show a strong link between knowledge level and recurrent stroke risk (Rahayu, 2020). Adequate knowledge is also associated with improved ability to recognise early stroke symptoms (Widiani and Yasa, 2023).

A preliminary survey of 52 Dental Technology and Dental Health students at Tanjung Karang Health Polytechnic showed that only 34.61% had good knowledge, while most students demonstrated inadequate attitudes toward post-stroke neurological disorders affecting oral health, highlighting the need for health education interventions.

Health education is a learning process that enables individuals or communities to develop and adopt healthier behaviours, with a focus on improving knowledge and attitudes as predisposing factors (Notoatmodjo, 2014). Health education is essential to improve awareness of post-stroke neurological disorders and their link to oral health, as studies in Nigeria have shown that stroke education effectively increases adolescents' awareness (Komolafe et al., 2020). A study in the United States found that virtual health education improved dental and occupational therapy students' understanding,

confidence, and readiness to manage the oral health of stroke patients (Umlauf, 2021). The Health Belief Model (HBM) is applicable, as it is proven effective for improving knowledge and attitudes in health education for both the general public (Bolon et al., 2021; Suirvi et al., 2022) and adolescents (Aisah et al., 2022; Harahap et al., 2024). This model was initially developed by combining stimulus-response theory and cognitive theory to explain why people fail to prevent or detect disease. It highlights four key concepts: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. During its development, components such as action cues and self-efficacy were added (Prabandari et al., 2022).

This study aimed to assess the effect of health education based on the Health Belief Model (HBM) on first-year Dental Technology and Dental Health students' knowledge and attitudes regarding post-stroke neurological disorders affecting oral health at Tanjung Karang Health Polytechnic. The study was conducted to address the need for students to understand these conditions in order to provide appropriate care.

## METHODS

This study used a quasi-experimental design with a non-equivalent control group and was carried out on October 2025 at the Department of Dental Technology and Dental Health, Tanjung Karang Health Polytechnic. All 159 first-year students made up the study population. 62 subjects were obtained by estimating the number of participants using the Slovin formula with a 10% margin of error; in reality, the sample size was expanded to 64 subjects. The sample was split into two groups of thirty-two subjects each: the experimental group and the control group. To ensure that every member of the population had an equal chance of being chosen, simple random sampling using a lottery approach was used for sample selection.

The initial assessment, intervention, and final evaluation phases of the study were conducted over the course of a single day. Knowledge and attitude questionnaires were used for both the initial and final evaluations. While the control group received traditional lectures, the experimental group received HBM-based health education through lectures, interactive discussions, case studies, and games. Twenty multiple-choice questions made up the knowledge instrument, and fifteen Likert scale statements structured in accordance with HBM components made up the attitude instrument. With reliability coefficients of 0.760 for knowledge and 0.753 for attitude, the instruments were judged valid and reliable by three experts and a trial test involving thirty participants from the study population. With the aid of SPSS version 26, data analysis was carried out using the Shapiro-Wilk test, Paired t-test, Independent t-test, Wilcoxon Signed Ranks Test, and Mann-Whitney tests. The Tanjung Karang Health Polytechnic's Health Research Ethics Committee has given this study ethical approval (No. 475/KEPK-TJK/IX/2025).

## RESULTS AND DISCUSSIONS

The study included 64 subjects, allocated into two groups: the experimental and control groups. Characteristics examined in this study were age, gender, department of education, and history of receiving health education on similar topics. The characteristics of subjects are described in the following Table 1.

**Table 1. Characteristics of subjects in the experimental and control groups (n = 64)**

| Characteristics | Category | Experimental Group (n = 32) | Control Group (n = 32) |
|---|---|---|---|
| **Age** | 17 years | 6 (19%) | 4 (12%) |
| | 18 years | 25 (78%) | 22 (69%) |
| | 19 years | 1 (3%) | 6 (19%) |
| **Gender** | Male | 5 (16%) | 3 (9%) |
| | Female | 27 (84%) | 29 (91%) |
| **Educational Major** | Dental Technology | 17 (53%) | 16 (50%) |
| | Dental Health | 15 (47%) | 16 (50%) |
| **History of Receiving Similar Health Education** | Yes | 0 (0%) | 0 (0%) |
| | No | 32 (100%) | 32 (100%) |

Source: Primary data, 2025

Based on subjects' characteristics, there were 32 subjects in each experimental and control group. By age, most subjects in both groups were 18 years old: 25 (78%) in the experimental group and 22 (69%) in the control group. In the experimental group, six subjects (19%) were aged 17 years, while four (12%) in the control group were in the same age category; meanwhile, one respondent (3%) in the experimental group and six (19%) in the control group were aged 19 years.

Based on gender, most subjects in both groups were female, with 27 (84%) in the experimental group and 29 (91%) in the control group; meanwhile, males comprised 5 (16%) and 3 (9%), respectively. In terms of educational majors, the composition of subjects was relatively balanced between Dental Technology and Dental Health, with 17 (53%) Dental Technology students and 15 (47%) Dental Health students in the experimental group, and 16 (50%) from each major in the control group. All subjects in both groups (100%) stated that they had never received health education on a similar topic.

Table 2 illustrates that there was no significant difference between the two groups' average knowledge scores prior to the intervention (pre-test), which were 9.13 and 9.47, respectively. Similarly, the experimental group's average attitude score was 44.53, while the control group's was 43.41. There was no discernible difference in the two groups' pre-test knowledge scores, according to an independent t-test of the knowledge variable, with a *p-value* (0.586) > 0.05. The Mann-Whitney U test for attitude produced a *p-value* of 0.309 (> 0.05), suggesting that the two groups' pre-intervention attitude ratings did not differ significantly. This suggests that the beginning knowledge and attitudes of the two groups were similar.

**Table 2. Description of knowledge and attitude scores before intervention**

| Score | N | Min | Max | Mean | Std. Deviation | Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Pre-test knowledge scores for the experimental group | 32 | 4 | 14 | 9.13 | 2.181 | 0.586[1] |
| Pre-test knowledge scores for the control group | 32 | 4 | 17 | 9.47 | 2.805 | |
| Pre-test attitude scores for the experimental group | 32 | 33 | 54 | 44.53 | 5.010 | 0.309[2] |
| Pre-test attitude scores for the control group | 32 | 35 | 48 | 43.41 | 3.320 | |

Note: *[1]Independent t-test, [2]Mann-Whitney U test, significant if p-value < 0.05

Furthermore, a normal distribution was revealed by the Shapiro-Wilk normality test on the difference in scores (post−pre) on the knowledge scores of the control group ($W$ = 0.95; $p$ = 0.224). As a result, a paired sample t-test was run. Table 3 displays the paired sample t-test findings. The control group's pre- and post-knowledge ratings differ significantly, as the table illustrates. With a standard error of 0.535, the average improvement in knowledge scores was 4.375 points (SD = 3.024). The average difference's 95% confidence interval was 3.285-5.465, suggesting that the increase was steady and unrelated to chance. The statistical significance of the difference between the pre-test and post-test scores is indicated by the *t-value* of 8.184 with df = 31 and $p$ < 0.001. As a result, after the assessment period, the control group showed a significant improvement in knowledge.

**Table 3. Changes in student knowledge before and after intervention in the experimental and control groups**

| Variable | Mean | Std. Deviation | Std. error mean | 95% CI of the difference | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| | | | | *Lower* | *Upper* | | | |
| **Experimental Knowledge (post-pre)** | 8.594 | 1.998 | 0.353 | 7.873 | 9.314 | 24.334 | 31 | <0.001* |
| **Control Knowledge (post-pre)** | 4.375 | 3.024 | 0.535 | 3.285 | 5.465 | 8.184 | 31 | <0.001* |

Note: *Paired t-test, significant if p-value < 0.05

Table 4 displays the Independent-Samples t-test findings. The experimental and control groups' post-test knowledge scores differ significantly, as the table illustrates. The findings of the analysis indicate that the difference in scores between the two groups is statistically significant, with a t-value of 6.585 and $p$ < 0.001. With a 95% confidence interval between 2.934 and 5.503, the experimental group's average post-test knowledge score was 4.219 points higher than the control group's. The experimental group's post-test knowledge increased significantly more than that of the control group. HBM-based interventions had a greater impact than the improvements seen in the control group, as evidenced by the statistically significant difference in test scores ($p$ < 0.05).

**Table 4. The effect of HBM-based health education on changes in student knowledge**

| Variable | *t* | Mean difference | 95% CI of the difference | | Std. Error Difference | *df* | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|
| | | | *Lower* | *Upper* | | | |
| **Difference in knowledge change (Experimental vs. Control** | 6.585 | 4.219 | 2.934 | 5.503 | 0.641 | 53.732 | <0.001* |

Note: *Independent t-test, significant if p-value < 0.05

A normal distribution was revealed by the Shapiro-Wilk normality test on the score difference (post−pre) ($W = 0.97$; $p = 0.663$). Consequently, a paired-samples t-test was carried out. Table 5 displays the Paired Samples t-test findings. The experimental group's pre- and post-attitude scores differed significantly, as the table illustrates. With a standard error of 1.498, the average increase in attitude scores was 20.281 points (SD = 8.475). The increase was steady and not erratic, as indicated by the 95% confidence interval of 17.226-23.337. The difference between the pre-test and post-test is statistically significant, according to the *t-value* = 13.538 with $df = 31$ and $p < 0.001$. Therefore, it can be said that the experimental group's attitude scores dramatically increased as a result of the intervention.

**Table 5. Changes in student attitudes in the experimental group before and after intervention**

| Variable | Mean | Std. Deviation | Std. Error mean | 95% CI of the difference | | *t* | *df* | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|
| | | | | Lower | Upper | | | |
| **Experimental Attitude (post-pre)** | 20.281 | 8.475 | 1.498 | 17.226 | 23.337 | 13.538 | 31 | <0.001* |

Note: *Paired t-test, significant if p-value < 0.05

The score differences were not normally distributed, according to the Shapiro-Wilk normality test ($W = 0.91$; $p = 0.018$). The nonparametric *Wilcoxon Signed-Rank* test was thus employed. Table 6 displays the Wilcoxon Signed Ranks Test results. The control group's pre- and post-test attitude scores change significantly ($Z = –4.944$; $p < 0.001$), according to the table. The majority of subjects' scores rose, suggesting that the control group's attitude ratings improved following the measurement period. The majority of participants had higher post-test scores than pre-test scores, according to the Change Value, which was computed from the rise in scores (positive rankings). The Z statistic's negative sign shows that post-test results were often greater than pre-test results.

**Table 6. Changes in student attitudes in the control group before and after intervention**

| Control Attitude (pre-post) | Z | Sig. (2-tailed) |
|---|---|---|
| | -4.944 | <0.001* |

Note: *Wilcoxon Signed Ranks, significant if p-value < 0.05

The Mann-Whitney U non-parametric test was utilised to assess the difference in attitude change because the Shapiro-Wilk normality test on the control group was not normally distributed. Table 7 displays the Mann-Whitney U test findings. The experimental and control groups' attitude scores differ significantly, as Table 7 demonstrates. With $p = 0.002$ ($p < 0.05$), the $Z$ value was –3.047 and the U value was 285.500. The difference in attitude improvement scores between the two groups is unlikely to have happened by chance if the *p-value* is less than 0.05. The experimental group's post-test attitude scores increased significantly more than those of the control group. It can be inferred that the Health Belief Model-based intervention had a more significant impact than the changes that took place in the control group because the difference in test results revealed a $p< 0.05$.

**Table 7. Differences in attitude changes in the experimental group compared to the control group**

| Difference in Attitude Change (Experiment versus Control) | Mann-Whitney U | Z | Sig. (2-tailed) |
|---|---|---|---|
| | 285.500 | -3.047 | 0.002* |

Note: *Mann-Whitney U test, significant if p-value < 0.05

According to statistical analyses, health education based on the Health Belief Model (HBM) is more successful than non-HBM education in raising students' attitudes and understanding about neurological illnesses that impair dental and oral health after a stroke. There haven't been any earlier studies looking at comparable problems. Nonetheless, the HBM is useful for enhancing knowledge, attitudes, and health-related behaviours when applied to other health education subjects. According to one study, giving families of TB patients HBM education greatly increased their knowledge ratings. (Bolon et al., 2021). This finding was reinforced by other studies that also found improvements in knowledge, attitude, perception, and preventive behaviour regarding hypertension and smoking cessation education after HBM intervention (Ravi et al., 2021; Suirvi et al., 2022). Similar consistency was seen in a study that proved that all components of HBM, including vulnerability, seriousness, benefits, barriers, and self-efficacy, increased significantly in adolescents after education was provided (Harahap et al., 2024).

HBM has been demonstrated to be successful in altering health-related behaviours in addition to its effects on cognitive processes. According to reports, HBM education improves dietary habits, such as consuming less energy, cholesterol, and saturated fat, in addition to raising risk perception in myocardial infarction patients (Fatahian et al., 2023). This shows that HBM can produce fundamental behavioural changes, not just knowledge. More broadly, HBM is an effective educational model for managing various chronic diseases, including hypertension, by increasing self-efficacy and reducing behavioural barriers (Kam and Lee, 2024). Therefore, the results of this study support evidence that HBM-based interventions are successful in raising participant awareness and fostering improved health. The similarity of results across studies shows that HBM is a consistent, valid, and applicable educational approach for various population groups.

Although the experimental group that received HBM-based health education demonstrated greater improvement in knowledge and attitude scores, the control group also showed significant improvement. This condition may have arisen because the research participants continued to receive health education, albeit through traditional methods. These results are in line with prior research demonstrating that health education improves participants' knowledge regardless of the approach, but effectiveness varies

(Aeni and Yuhandini, 2018). Similar results were reported in studies employing the same process, in which the control group, which received only lectures, still showed an increase in knowledge scores. But compared to the intervention group, the increase was not as notable (Ulya et al., 2017). Thus, health education, in any form, still has a positive effect on knowledge. However, more ideal alterations can be achieved by using more structured techniques or media, such as the HBM-based approach.

The intervention's impact on the experimental group in this study was significantly higher than that on the control group because the instruction was created to incorporate all of the HBM's components in addition to imparting knowledge. Regarding perceived susceptibility, participants were informed about the risks of disorders such as muscle weakness, speech disorders, coordination difficulties, and oral function problems, so that they recognised that anyone could experience these conditions if risk factors were not controlled. This aligns with several studies indicating that health education can increase perceived susceptibility to the topic under study (Azadi et al., 2021; Khodaveisi et al., 2021; Pribadi and Devy, 2020; Vahedian-Shahroodi et al., 2021). Participants' perceptions of the seriousness of the significance of appropriate management are reinforced by the emphasis on the severe post-stroke outcomes, such as decreased quality of life and increased chance of disability. Emphasising the seriousness of potential impacts can increase perceived severity (Azadi et al., 2021; Pribadi and Devy, 2020; Khodaveisi et al., 2021).

The intervention also identifies early detection, rehabilitation exercises, and oral health care as perceived benefits that can accelerate recovery and prevent symptom worsening. This is in line with recent research showing that subjects' perceptions of advantages can be raised by HBM-based health education (Azadi et al., 2021; Khodaveisi et al., 2021; Pribadi and Devy, 2020). Barriers, such as the assumption that post-stroke care is difficult or costly, are eliminated by providing explanations that use simple, realistic steps. Thus, subjects' perceived barriers may increase, consistent with other studies (Azadi et al., 2021; Khodaveisi et al., 2021; Pribadi and Devy, 2020). Additionally, participants' self-efficacy in applying the instructional material was raised by the use of straightforward language, specific examples, and useful instructions (Azadi et al., 2021; Khodaveisi et al., 2021; Pribadi and Devy, 2020). Cues to action were provided through demonstrations and case studies presented as games that encouraged participants to think critically and take action. This was done as a trigger for action, to increase the desire to take beneficial actions and overcome their barriers (Khodaveisi et al., 2021).

The experimental group was given two types of educational games and divided into eight small groups. The first game, Brain Tap, required participants to memorise, for over 10 minutes, terms related to post-stroke neurological disorders that affect dental and oral health while viewing the monitor. After that, they worked on a case sheet to identify the appropriate type of neurological disorder within 5 minutes. The second game, Perfect Match, asked each group to match 10 cases with randomly provided HBM components by connecting the correct pairs with lines within 10 minutes. This game was designed to reinforce conceptual understanding through interactive and collaborative activities. This aligns with research showing that remembering, memorising, and visualising are effective for increasing knowledge (Vorona-Slivinskaya et al., 2020). The findings of this study are also in line with earlier research demonstrating that students favour game-based learning due to its potential to boost motivation, emotional involvement, and enjoyment (Hartt et al., 2020). This was demonstrated in the experimental group, where playing

educational games boosted their engagement and zeal for comprehending the subject matter.

Overall, the incorporation of health education materials based on the Health Belief Model (HBM) was successful in influencing participants' perceptions and preparedness to manage post-stroke neurological disorders that affect oral health, as well as improving students' knowledge and attitudes about these disorders. Although students from both departments are not directly involved with stroke patients, several studies have shown that stroke is related to oral health. A qualitative study in New Zealand revealed that stroke survivors experience various oral health and functional impairments, including difficulty swallowing, reduced chewing efficiency, changes in oral sensation, and decreased oral hygiene practices (Cheong, 2024). Another Hungarian study found that stroke survivors had poor oral and dental health (Moldvai et al., 2022). Research in Northern England identified two main factors contributing to a decline in oral health among post-stroke patients: neurological deficits and barriers to daily oral care. Neurological deficits, such as facial paralysis and difficulty chewing and swallowing, impair oral function and self-care independence. Meanwhile, barriers to oral care arise from physical limitations and patient motivation, insufficient attention to oral health by medical personnel, and inadequate facilities (BaHammam et al., 2023). A meta-analysis study shows that stroke patients have poorer oral health compared to non-stroke patients, with more cavities, fewer remaining teeth, and higher plaque and gingival indices, indicating more severe periodontal disease (Zeng et al., 2020). Therefore, this knowledge is essential for students from both departments, as understanding it enables them to provide care and services appropriate to patients' needs.

These findings have important implications for health education, particularly the need to integrate the HBM approach and game-based learning into the learning process and to develop sustainable, interactive learning media and curricula. However, this study has limitations regarding the measurement duration, which is not yet long-term, and the sample size, which remains limited. Therefore, further research is recommended that involves a broader, more diverse sample and evaluates the long-term impact and development of technology-based interventions to improve the effectiveness of health education.

## CONCLUSIONS

This study finds that health education based on the Health Belief Model (HBM) is effective in improving students' knowledge and attitudes regarding post-stroke neurological disorders and their impact on oral health. Compared to conventional methods, the HBM approach enhances understanding of disease risk, severity, benefits of prevention, and motivation to adopt positive health behaviors, resulting in better cognitive and attitudinal outcomes. It is recommended that HBM be used as a framework for oral health promotion, particularly for neurological conditions. Educational institutions should integrate HBM-based education into curricula to improve awareness and preventive attitudes. To evaluate long-term behavioural and clinical results, future studies should include larger samples, a wider range of groups, and longer follow-up.

## ACKNOWLEDGMENTS

We express our gratitude to everyone who participated in this research.

## CONFLICT OF INTEREST

Regarding this study, there are no conflicts of interest.

## REFERENCES

Aeni, N., Yuhandini, D.S., 2018. Pengaruh Pendidikan Kesehatan dengan Media Video dan Metode Demonstrasi terhadap Pengetahuan SADARI. Jurnal Ilmu Pengetahuan 6(2), 162-175. https://jurnal.unitri.ac.id/index.php/care/article/view/929/pdf

Aisah, S., Ismail, S., Margawati, A., 2022. Animated Educational Video using Health Belief Model on The Knowledge of Anemia Prevention Among Female Adolescents: An Intervention Study. Malaysian Family Physician 17(3), 97–104. Https://Doi.Org/10.51866/Oa.136

Azadi, N.A., Ziapour, A., Lebni, J.Y., Irandoost, S.F., Abbas, J., Chaboksavar, F., 2021. The Effect of Education Based on Health Belief Model on Promoting Preventive Behaviors of Hypertensive Disease in Staff of The Iran University of Medical Sciences. Archives of Public Health 79(1), 1-8. Https://Doi.Org/10.1186/S13690-021-00594-4

Bahammam, F., Durham, J., Abdulmohsen, B., Wassall, R., Mccracken, G.I., 2023. Oral Health Decline in Patients After Stroke: A Qualitative Study. British Dental Journal 235(11), 881–885. Https://Doi.Org/10.1038/S41415-023-6558-2

Bolon, C.M.T., Pasaribu, V.R., Manurung, R., Situmorang, P.R., 2021. Efektivitas Pemberian Kesehatan The Health Belief Model terhadap Pengetahuan Keluarga Tentang TB Paru di RS TNI AL Dr. Komang Makes Belawan. Jurnal Ilmiah Keperawatan Imelda 7(2), 137-141. https://jurnal.uimedan.ac.id/index.php/jurnalkeperawatan/article/view/530

British Society of Gerodontology., 2010. Guidelines for The Oral Healthcare of Stroke Survivors [WWW Document]. https://www.gerodontology.com/content/uploads/2014/10/stroke_guidelines.pdf. [Accessed 18 July 2025].

[CDC] Centers for Disease Control and Prevention., 2024. About Stroke [WWW Document]. https://www.cdc.gov/stroke/about/index.html. [Accessed 10 July 2025].

Cheong, E., 2024. The Effects of Stroke on Oral Function and Oral Health: A Qualitative Study. [Thesis]. University of Otago, New Zealand.

Dewi, D.S., Asman, A., 2021. Resiko Stroke pada Usia Produktif di Ruang Rawat Inap RSUD Pariaman. Journal Scientific of Mandalika 2(11), 576-581. https://ojs.cahayamandalika.com/index.php/jomla/article/view/487

Ekker, M.S., Verhoeven, J.I., Vaartjes, I., Van Nieuwenhuizen, K.M., Klijn, C.J.M., De Leeuw, F.E., 2019. Stroke Incidence in Young Adults According to Age, Subtype, Sex, and Time Trends. Neurology Journals 92(21), e2444-e2454. Https://Doi.Org/10.1212/Wnl.0000000000007533

Fadli, N., 2023. Waspada Stroke di Usia Muda [WWW Document]. https://rs.ui.ac.id/umum/berita-artikel/artikel-populer/waspada-stroke-di-usia-muda. [Accessed 9 September 2025].

Fatahian, F., Shahnazi, H., Hassanzadeh, A., Mohammadifard, N., 2023. Effect of Education Based on Health Belief Model on The Dietary Intake of Patients with A Myocardial Infarction. Arya Atherosclerosis Journal 19(4), 19–28.

Https://Doi.Org/10.48305/Arya.2022.41123.2848

GBD 2019 Stroke Collaborators., 2021. Global, Regional, and National Burden of Stroke and Its Risk Factors, 1990–2019: A Systematic Analysis for The Global Burden of Disease Study 2019. The Lancet Neurology 20(10), 795–820. Https://Doi.Org/10.1016/S1474-4422(21)00252-0

Handayani, F., 2019. Pengetahuan tentang Stroke, Faktor Risiko, Tanda Peringatan, Respon Mencari Bantuan, dan Tatalaksana pada Pasien Stroke Iskemik di Kota Semarang. Jurnal Ilmu Keperawatan Medikal Bedah 2(2), 12–51. https://doi.org/10.32584/jikmb.v2i2.406

Harahap, N.H., Hadi, A.J., Ahmad, H., 2024. The Effectiveness of Health Education using The Health Belief Model (HBM) Approach Toward Knowledge Level of Adolescent Reproductive Health at MTSN 3 Padangsidimpuan. Media Publikasi Promosi Kesehatan Indonesia 7(2), 463–471. Https://Doi.Org/10.56338/Mppki.V7i2.4944

Hartt, M., Hosseini, H., Mostafapour, M., 2020. Game on: Exploring The Effectiveness of Game-Based Learning. Planning Practice and Research 35(5), 589–604. Https://Doi.Org/10.1080/02697459.2020.1778859

Kam, B.S., Lee, S.Y., 2024. Integrating The Health Belief Model Into Health Education Programs in A Clinical Setting. World Journal of Clinical Cases 12(33), 6660–6663. Https://Doi.Org/10.12998/Wjcc.V12.I33.6660

[Kemenkes] Kementerian Kesehatan., 2019. Pedoman Nasional Pelayanan Kedokteran Tata Laksana Stroke. Kementerian Kesehatan RI, Jakarta.

[Kemenkes] Kementerian Kesehatan., 2023. Survei Kesehatan Indonesia Tahun 2023. Kementerian Kesehatan RI, Jakarta.

Khodaveisi, M., Azizpour, B., Jadidi, A., Mohammadi, Y., 2021. Education Based on The Health Belief Model to Improve The Level of Physical Activity. Physical Activity and Nutrition 25(4), 17–23. Https://Doi.Org/10.20463/Pan.2021.0022

Komolafe, M.A., Olorunmoteni, O.E., Fehintola, F.O., 2020. Effect of Health Education on Level of Awareness and Knowledge of Nigerian in-School Adolescents on Stroke and its Risk Factors. Journal of Stroke and Cerebrovascular Diseases 29(5), 1-12. Https://Doi.Org/10.1016/J.Jstrokecerebrovasdis.2020.104757

Moldvai, J., Orsós, M., Herczeg, E., Uhrin, E., Kivovics, M., Németh, O., 2022. Oral Health Status and Its Associated Factors Among Post-Stroke Inpatients: A Cross-Sectional Study in Hungary. BMC Oral Health 22(1), 1-9. Https://Doi.Org/10.1186/S12903-022-02259-2

Mubaraki, A.A., Alqahtani, A.S., Almalki, A.A., Almalki, A.H., Alamri, H.M., Aburass, M.K., Althumali, Z.H., 2021. Public Knowledge and Awareness of Stroke Among Adult Population in Taif City, Saudi Arabia. Neurosciences 26(4), 339–345. Https://Doi.Org/10.17712/Nsj.2021.4.20210057

Notoatmodjo, S., 2014. Kesehatan Masyarakat-Ilmu dan Seni. Rineka Cipta, Jakarta.

Prabandari, Y.S., Padmawati, R.S., Supriyati, Hasanbasri, M., Dewi, F.S.T., 2022. Ilmu Sosial dan Perilaku. Gadjah Mada University Press, Sleman.

Pribadi, E.T., Devy, S.R., 2020. Application of The Health Belief Model on The Intention to Stop Smoking Behavior Among Young Adult Women. Journal of Public Health Research, 9(2), 1-12. Https://Doi.Org/10.4081/Jphr.2020.1817

Rachmawati, D., Marshela, C., Sunarno, I., 2022. Differences in Risk Factors for Stroke in The Elderly and Adolescents. Bali Medika Jurnal 9(3), 207–221. https://balimedikajurnal.com/index.php/bmj/article/view/281

Rahayu, T.G., 2020. Hubungan Pengetahuan dan Sikap Keluarga dengan Risiko Kejadian Stroke Berulang. Jurnal Ilmiah Kesehatan Pencerah 9(2), 140–146.

Ravi, K., Indrapriyadharshini, K., Madankumar, P.D., 2021. Application of Health Behavioral Models in Smoking Cessation - A Systematic Review. Indian Journal of Public Health 65(2), 103–109. Https://Doi.Org/10.4103/Ijph.Ijph_1351_20

Schmalz, G., Li, S., Ziebolz, D., 2022. Oral Health-Related Quality of Life in Patients After Stroke A Systematic Review. Journal of Clinical Medicine 11(5), 1-13. Https://Doi.Org/10.3390/Jcm11051415

Skajaa, N., Adelborg, K., Horváth-Puhó, E., Rothman, K.J., Henderson, V.W., Casper Thygesen, L., Toft Sørensen, H., 2021. Nationwide Trends in Incidence and Mortality of Stroke Among Younger and Older Adults in Denmark. Neurology 96(13), e1711-e1723. Https://Doi.Org/10.1212/Wnl.0000000000011636

Suirvi, L., Herlina, H., Dewi, A.P., 2022. Efektivitas Pendidikan Kesehatan Berbasis The Health Belief Model pada Penderita Hipertensi. Jurnal Ners Indonesia 12(2), 114-121. https://doi.org/10.31258/jni.12.2.114-121

Tater, P., Pandey, S., 2021. Post-Stroke Movement Disorders. Neurology India, 69(2), 272–283. Https://Doi.Org/10.4103/0028-3886.314574

Ulya, Z., Iskandar, A., Asih, F.T., 2017. Pengaruh Pendidikan Kesehatan dengan Media Poster terhadap Pengetahuan Manajemen Hipertensi pada Penderita Hipertensi. Soedirman Journal of Nursing 12(1), 38-46.

Umar, A.B., Koehler, T.J., Zhang, R., Gilbert, V., Farooq, M.U., Davis, A.T., Nyenhuis, D., Gorelick, P.B., 2019. Stroke Knowledge Among Middle and High School Students. Journal of International Medical Research 47(9), 4230–4241. Https://Doi.Org/10.1177/0300060519858887

Umlauf, M., 2021. Interprofessional Education Between Dental Hygiene and Occupational Therapy Students in Relation to Stroke Care Occupational Therapy Students in Relation to Stroke. [Thesis]. Eastern Washington University.

Vahedian-Shahroodi, M., Tehrani, H., Robat-Sarpooshi, D., Gholian Aval, M., Jafari, A., Alizadeh-Siuki, H., 2021. The Impact of Health Education on Nutritional Behaviors in Female Students: An Application of Health Belief Model. International Journal of Health Promotion and Education 59(2), 70–82. Https://Doi.Org/10.1080/14635240.2019.1696219

Vorona-Slivinskaya, L., Bokov, D., Li, O., 2020. Visualization of Learning and Memorizing Processes using Mobile Devices: Mind Mapping and Charting. International Journal of Interactive Mobile Technologies 14(21), 136–152. Https://Doi.Org/10.3991/Ijim.V14i21.18475

Wanichanon, W., Ananchaisarp, T., Buathong, N., Choomalee, K., 2024. Knowledge and Attitude Towards Stroke Among The Population of One Rural Community in Southern Thailand: A Survey. BMJ Open 14(2), 1-10. Https://Doi.Org/10.1136/Bmjopen-2023-080269

Widiani, G.A.R., Yasa, I.M.M., 2023. Korelasi Tingkat Pengetahuan terhadap Kemampuan Deteksi Dini Gejala Stroke dengan Sikap Keluarga terhadap Penanganan Pre Hospital. Bina Generasi Jurnal Kesehatan 14(2), 25-30. https://doi.org/10.35907/bgjk.v14i2.255

Zeng, L.N., Rao, W.W., Luo, S.H., Zhang, Q.E., Hall, B.J., Ungvari, G.S., Chen, L.G., Xiang, Y.T., 2020. Oral Health in Patients with Stroke: A Meta-Analysis of Comparative Studies. Topics in Stroke Rehabilitation 27(1), 75–80. Https://Doi.Org/10.1080/10749357.2019.1656413