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Self Awareness Behaviour Model in Controlling Blood Sugar Levels in Type 2 Diabetes Mellitus Patients Based on Animated Video Media

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ABSTRACT

Introduction: Type 2 Diabetes Mellitus (T2DM) is a global health issue with a steadily increasing prevalence. The ability to self-manage effectively, supported by enhanced patient awareness, is paramount in ensuring optimal blood sugar control and averting complications. Animated videos grounded in local wisdom have the potential to serve as an effective educational intervention, especially in regions with limited access to health information.

Aim: This study aims to develop a behavioural model of self-awareness in controlling blood sugar levels in patients with type 2 diabetes mellitus, based on animated video media in coastal areas.

Method: The research design used was a quasi-experiment with a Nonequivalent Control Group Design approach. The population of this study were T2DM patients in Riau Province, with a sample of 600 people selected using purposive sampling technique. The instruments used were questionnaires and animated videos as treatment. Data were analysed using Wilcoxon Signed Rank Test and path analysis.

Results: Animated videos significantly increased self-awareness among DMT2 patients regarding blood sugar control across all study regions. Wilcoxon test results showed statistical significance ($p < 0.05$) in all regions. The Z-values and p-values for each region are as follows: Pekanbaru ($Z = -7.773$, $p < 0.0005$), Pelalawan ($Z = -3.776$, $p < 0.0005$), Dumai ($Z = -2.933$, $p = 0.003$), Bagan ($Z = -4.183$, $p < 0.0005$), and Bengkalis ($Z = -3.977$, $p < 0.0005$). However, in Siak, the Wilcoxon test results were not significant ($Z = -1.144$, $p = 0.253$). The overall effect of the intervention was classified as weak, as indicated by the low R Square values (0.04 - 0.10).

Conclusion: The animated video intervention is effective in improving self-awareness of T2DM patients in urban and coastal areas. However, the low R Square value indicates that other factors besides the animated video intervention also play an important role in patient self-awareness. Further research is needed to identify and quantify these factors.

Keywords: *Type 2 diabetes mellitus, Video animation, Self-awareness, Blood sugar management, Health education*

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1. INTRODUCTION

Diabetes mellitus (DM) is a growing global health problem that has the potential to cause serious complications leading to increased mortality [1], [2] . DM consists of two main types, type 1 DM and type 2 DM, both of which are characterised by hyperglycaemia caused by abnormalities in insulin secretion, insulin action, or both [3], [4] . Common symptoms of DM include polyuria, polydipsia, polyphagia, weight loss, and blurred vision. In type 2 DM, insulin resistance and decreased insulin secretion are the main signs that can vary from relative deficiency to dominant [5] . According to the International Diabetes Federation (IDF), it is estimated that by 2024, around 589 million adults aged 20-79 years will be living with diabetes, and this number is predicted to increase to 853 million by 2050 [6]. In addition, data

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from the World Health

Organization (WHO) shows that in 2022, approximately 830 million adults worldwide suffered from diabetes, a figure that is significantly higher than the 200 million recorded in 1990. The prevalence of diabetes among adults has more than doubled, from 6.8% in 1990 to 14.1% in 2022, with more than half of these individuals undiagnosed or not receiving adequate treatment. [7] . In Indonesia, the situation of diabetes is of increasing concern, with the 2018 Riskesdas data showing the prevalence of doctor-diagnosed Type 2 Diabetes Mellitus (T2DM) in the population aged ≥15 years at 2%. This figure shows an increase compared to the 2013 Riskesdas which recorded a prevalence of 1.5%[8].

T2DM is at risk of causing serious complications such as cardiovascular disease, stroke, blindness, and kidney failure, which not only jeopardise the patient's health but also affect the family's economy [9] . DM management requires strict blood sugar control through lifestyle changes, diet, stress management, and medication. However, many patients struggle to raise their self-awareness of the importance of blood sugar control and the necessary self-care management [10]. Self-awareness is essential in the management of DM, which includes understanding the body's condition, triggering factors, and the ability to manage health responses [11], [12].

Despite the fact that effective management of diabetes mellitus (DM) demands strict control of blood sugar levels, many patients nevertheless encounter challenges in enhancing their self-awareness. This is indicative of an absence of comprehension regarding the implementation of management measures, including but not limited to regular blood sugar monitoring, dietary modifications, and stress management. This necessitates the development of innovative approaches, such as the use of animated videos, which have the capacity to convey complex health information in a more engaging and easily understandable manner for patients, particularly in areas where health information resources are limited. A plethora of research has demonstrated that educational videos, encompassing animated videos, have the capacity to enhance health literacy and promote optimal diabetes management behaviours [13] . In addition, the animated video-based educational module improved clinical self-care skills and blood sugar control in patients with type 2 diabetes and influenced disease perception and self-efficacy of patients with diabetes [15]. The animated video intervention was also shown to improve the knowledge of elderly patients regarding diabetes self-management [16].

Self-regulation models in diabetes management are significantly influenced by patient self-awareness. However, many extant models have not fully integrated self-regulation with technology-based interventions, such as the use of animated videos. The utilisation of technology in health education, including mobile applications and telemedicine, has demonstrated favourable outcomes in the domain of diabetes self-management. However, the application of animated videos as an educational medium remains under-explored. However, the long-term effects of utilising animated videos in diabetes management, particularly in self-regulation and blood sugar management, still require further research [19].

The self-regulation model in diabetes management is strongly influenced by the patient's self-awareness [17], [18] . Psychological factors such as stress and mental health are often overlooked in the management of diabetes, even though stress can worsen blood sugar control and affect the well-being of patients. By utilising animated videos that teach how to manage stress, it is hoped that it can reduce the psychological impact and increase patient motivation in carrying out therapy [19], [20] . However, many extant models have not fully integrated self-regulation with technology-based interventions, such as the use of animated videos. The utilisation of technology in health education, including mobile applications and telemedicine, has demonstrated favourable outcomes in the domain of diabetes self-management. However, the application of animated videos as an educational medium remains under-explored. However, the long-term effects of utilising animated videos in diabetes management, particularly in self-regulation and blood sugar management, still require further research [21].

An animated video-based intervention to improve self-awareness and glycaemic control in patients with T2DM. Comparative studies between the use of animated videos and traditional educational methods, such as brochures or face-to-face counselling, need to be conducted to assess their effectiveness in diabetes self-management. Longitudinal studies are also needed to evaluate the long-term impact of animated videos on blood sugar management, as well as changes in self-efficacy and patient engagement in their diabetes management [19] . The objective of this study is to develop a behavioural model of self-awareness in controlling blood sugar levels of type 2 diabetes mellitus patients based on animated video media in coastal and urban areas. The hypothesis is that this will improve diabetes management, improve blood sugar control, and reduce diabetes complications. This will provide a new contribution to the development of technology-based health education interventions that are widely accessible, especially in areas that have limited health information resources.

2. METHOD

Research Design

The present study employed a quasi-experimental design, utilising a Nonequivalent Control Group Design approach. The experimental and control groups will undergo an initial measurement (pretest) prior to treatment, and a final measurement (posttest) following treatment. The two groups were not randomly selected. The experimental group received treatment in the form of animated videos, while the control group did not receive such treatment.

Research Location and Time

This study will be conducted in Riau Province, on T2DM patients in coastal and urban communities. The choice of location is based on demographic data from the Riau Provincial Health Office, which recorded the number of T2DM patients at 90,796 people. The study will be conducted over a specified period of time in accordance with the availability of participants and an agreed schedule.

Population and Study Sample

The target population in this study comprised all T2DM patients recorded in the data of the Riau Provincial Health Office for the past year, with 49,286 respondents in urban areas and 18,741 respondents in coastal areas. The research sample was selected to include coastal areas, specifically the city of Dumai, Bengkalis District, and Rokan Hilir District, while urban areas included Siak District, Pelalawan District, and the city of Pekanbaru. The selection of these areas is intended to ensure the representation of T2DM patients from both geographical regions.

Sample Criteria

Participants in this study had to fulfil the following inclusion criteria: (1) willing to be a respondent and provide informed consent, (2) diagnosed with Type 2 Diabetes Mellitus, and (3) in a conscious condition and able to answer research questions. Exclusion criteria include: (1) had significant hearing or visual impairment that hindered participation, and (2) were not willing to participate in all stages of the study.

Sample Size

The present study involved a total of 600 subjects recruited from six regions in Riau Province. A total of 100 respondents were selected from each of the designated regions, namely Bengkalis, Dumai, and Rokan Hilir for coastal areas, and Pekanbaru, Siak, and Pelalawan for urban areas. The equal allocation of samples across each region is intended to ensure a balanced representation of both types of geographical area. Despite the absence of formal statistical sample size calculations to determine the optimal number, it is asserted that 600 is adequate to provide an initial overview of the potential effectiveness of animated video interventions in various geographical contexts in Riau Province. The selection of 100 respondents per region is based on practical considerations related to research resources and logistical capabilities in reaching the population in fairly large areas.

Research Variables

This study investigates the effect of local wisdom-based animated video intervention on self-awareness of Type 2 Diabetes Mellitus patients in managing blood sugar levels. The independent variable is Animated Video, while the dependent variable is Self-Awareness in Blood Sugar Control. Self-awareness is defined as the patient's understanding and confidence in performing blood sugar management actions, including regular monitoring, lifestyle changes, adherence to a diabetic diet, and stress management.

The dependent variable is measured using a questionnaire that covers aspects such as adherence to blood sugar checks, lifestyle changes, diet, and stress management. The total score of the questionnaire will be categorised as positive if the respondent's score is at or above the mean value, and negative if below that value. The measurement scale for the dependent variable is ordinal.

Sampling Procedure and Data Collection

The present study employed a purposive sampling technique. The sampling process in each region involved collaboration with community health centres. Researchers collaborated with community health centres to identify and recruit participants who met the inclusion criteria and did not meet the exclusion criteria that had been set. Potential participants will be provided with an explanation of the research objectives, the procedures to be followed, the benefits and risks of participation, as well as their rights as respondents (informed consent). Participants who consent to participate in the study by signing the informed consent form will be included in the study.

Data collection will be conducted in two stages: pretest and posttest. At the pretest stage, prior to the delivery of the animated video intervention, participants from the experimental group and control group will be asked to fill out a questionnaire measuring the level of self-awareness in controlling blood sugar levels. This questionnaire will be completed independently under the supervision of the researcher.

After the pretest stage, the experimental group will receive an intervention in the form of watching an educational animated video on diabetes management for a period of approximately 60 minutes. The control group will not receive this intervention during the same period.

At the posttest stage, after the intervention period is over, the same questionnaire will be re-administered to participants from both groups to measure changes in the level of self-awareness in controlling blood sugar levels. The process of filling out the questionnaire at the posttest stage will be carried out using the same method as in the pretest stage. All data

collected will be kept confidential and used only for the purposes of this study.

Statistical Analysis

Statistical analysis in this study was used to test the effect of animated videos on self-awareness of Type 2 Diabetes Mellitus patients. Respondents' demographic data were analysed descriptively to describe the distribution of sample characteristics. To test the effect of animated videos on self-awareness, the Wilcoxon Signed Rank Test was used on pretest and posttest data. This test is used to measure significant differences between pretest and posttest scores in the experimental and control groups.

In addition, to analyse the relationship between self-awareness variables and influencing factors, path analysis was conducted. The results of path coefficient data processing are presented for each region (urban and coastal). To measure the level of influence of the animation video on behaviour change, the R Square value was used, which describes the proportion of variance that can be explained by the model.

3. RESULTS

Table 1. Distribution of Respondent Characteristics

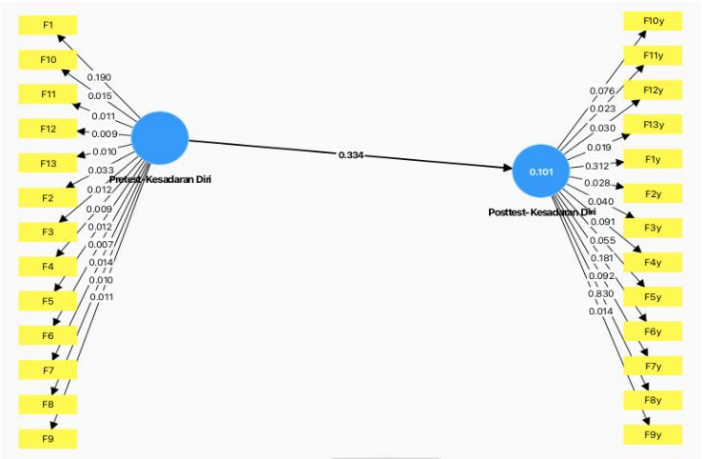
Characteristics	n	%
Age		
< 20 years old	26	4,3
20- 30 years old	68	11,3
31-40 years old	111	18,5
41-48 years old	395	65,8
Gender		
Male	210	35,0
Female	390	65,0
Education		
Elementary School	119	19,8
Junior High School	123	20,5
Senior High School	241	40,2
Higher Education	107	21,5
No Formal Education	10	1,7
Occupation		
Housewife	275	45,8
Government Employee	58	9,7
Farmer/Fisherman	88	14,7
Entrepreneur	86	14,3
Unemployed	49	8,2
Total	**600**	**100**

Table 1 shows the distribution of demographic characteristics of 600 respondents in this study. The majority of respondents were in the age range of 41-48 years (65.8%) and most were female (65.0%). In terms of education, most respondents had a high school education (40.2%). In terms of occupation, most respondents were housewives (45.8%).

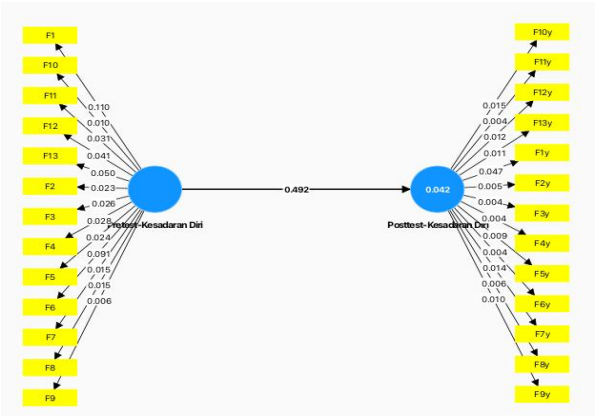
Table 2. The effect of video animation on self-awareness in controlling blood sugar levels in patients with Type 2 diabetes in urban and coastal areas

Region	Z	P value
Urban		
Pekan baru	-7.773	0.0005
Pelalawan	-3.776	0.0005
Siak	-1.144	0.253
Coastal		
Dumai	-2.933	0,003
Bagan	-4.183	0.0005
Bengkalis	-3.977	0.0005

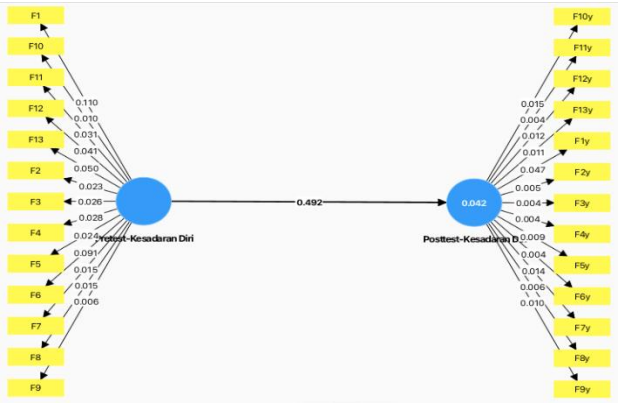
Table 2 presents the results of the analysis of the effect of animated videos on self-awareness in controlling blood sugar levels in patients with Type 2 diabetes in urban and coastal areas. The results of the analysis show that in urban areas, animated videos have a significant effect in Pekanbaru (Z = -7.773, P = 0.0005) and Pelalawan (Z = -3.776, P = 0.0005). However, in Siak (Z = -1.144, P = 0.253), the effect of the animated video was not significant. Meanwhile, in coastal areas, the effect of animated videos was significant in Dumai (Z = -2.933, P = 0.003), Bagan (Z = -4.183, P = 0.0005), and Bengkalis (Z = -3.977, P = 0.0005), all of which showed P values < 0.05, indicating a strong effect.



(a) Pekanbaru



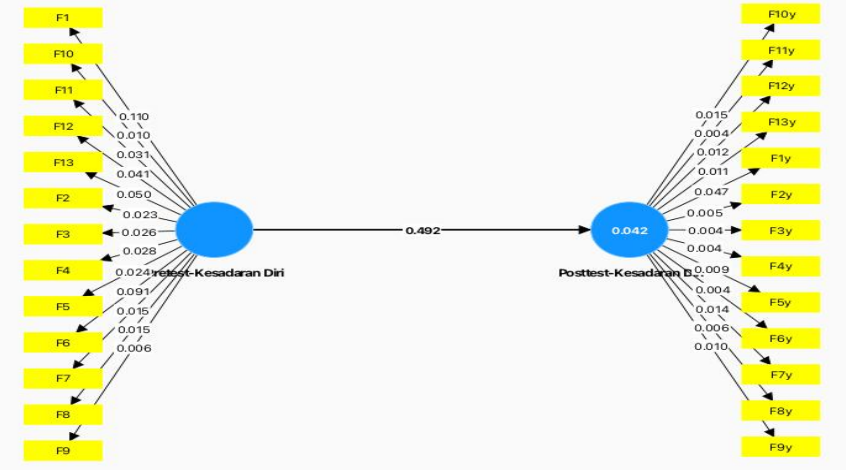
(b) Pelalawan



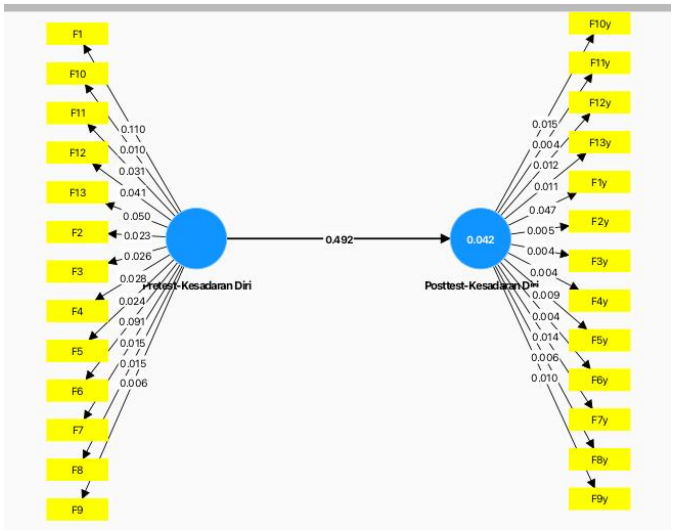
(c) Siak

Figure 1. Results of Path Coefficient data processing Self-awareness of urban areas

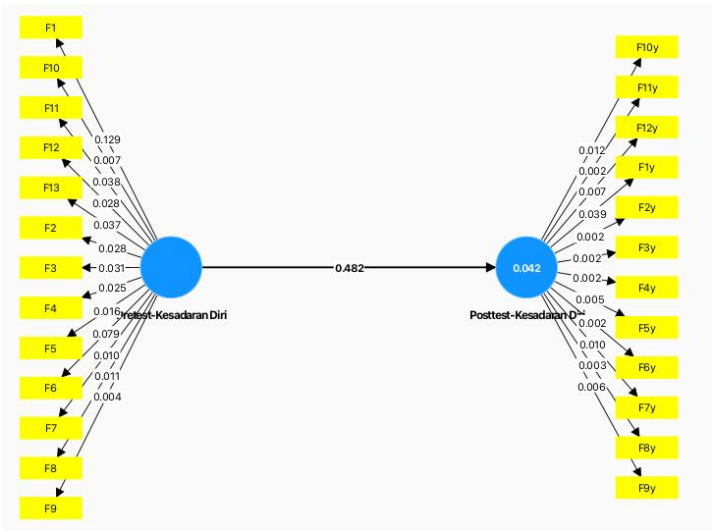
Figure 1 shows the results of Path Coefficient data processing for self-awareness in urban areas consisting of three regions: Pekanbaru, Pelalawan, and Siak. Each diagram illustrates the relationship between the self-awareness variable and the factors that influence it. Based on the results of the analysis, in Pekanbaru (Figure a) an R Square value of 0.101 was obtained, which shows that the effect of animated videos on changes in dietary patterns in the posttest is relatively weak. In Pelalawan (Figure b), the R Square value of 0.042 also indicates a weak influence, while in Siak (Figure c), the same R Square value also indicates a weak influence.



(a) Dumai



(b) Bagan



(c) Bengkalis

Figure 2. Results of Path Coefficient data processing Self-awareness of coastal areas

Figure 2 shows the results of Path Coefficient data processing for self-awareness in coastal areas consisting of Dumai, Bagan, and Bengkalis. Each diagram illustrates the relationship between the self-awareness variable and the factors that influence self-awareness. Based on the results of the analysis, in Dumai (Figure a), the R Square value of 0.042 was obtained, which shows that the effect of animated videos on changes in dietary patterns on the posttest is weak. In Bagan (Figure b), the R Square value of 0.042 also indicates a weak effect, while in Bengkalis (Figure c), the same R Square value indicates a weak effect.

4. DISCUSSION

This study comprehensively demonstrated the positive effect of local wisdom-based animated video intervention on increasing self-awareness of Type 2 Diabetes Mellitus patients in managing blood sugar levels, both in urban and coastal areas of Riau Province. These findings significantly strengthen the existing evidence base regarding the effectiveness of

animated videos as an innovative and engaging health education modality for the diabetes patient population [13], [22]. The observed improvement in self-awareness is in line with the literature highlighting the important role of visual media in facilitating the understanding of complex health information, especially for individuals who may face limitations in accessing conventional health information sources [23].

In urban areas, the impact of animated videos on enhancing self-awareness was observed in Pekanbaru and Pelalawan, yet this effect was not significant in Siak. This phenomenon may be attributable to variations in health literacy levels, the increased availability of a more diverse range of health information sources, and socio-economic differences between urban and non-urban areas. As has been emphasised in previous systematic reviews, low health literacy can act as a significant barrier to understanding and applying health information. Populations with low health literacy may be more responsive to visual education approaches such as animated videos due to the simplified and more accessible presentation of information [24]. Nonetheless, the positive results in some urban areas confirm the potential of animated videos as a valuable educational supplement, in line with research demonstrating their ability to improve patient understanding and motivation to adopt healthy behaviours, including physical activity [25].

Socioeconomic disparities between urban areas may also exert a substantial influence. It has been demonstrated by further research conducted in Indonesia that socioeconomic disparities exist with regard to the utilisation of diabetes-related health services. The findings indicate that individuals with different socioeconomic status may have different levels of access to and utilisation of health resources, which may affect their level of self-awareness and disease management capabilities. In this context, urban areas with higher socioeconomic levels may have populations that are already more exposed to various sources of health information, so the additional influence of video interventions may not be as great as in areas with lower socioeconomic levels [26]. Moreover, these findings are corroborated by studies demonstrating that mobile health (mHealth) based educational videos can generally enhance health literacy and healthier lifestyle behaviours in patients with chronic diseases such as diabetes [23].

Conversely, the consistent positive effect of the animated videos across coastal areas (Dumai, Bagan Sinembah, and Bengkalis) underscores the effectiveness of this intervention in a context with potentially limited access to health information. Geographical and infrastructural limitations are often a barrier to accessing comprehensive health services and information in coastal areas. In this context, animated videos offer a solution that is accessible, visually appealing, and effective in delivering key messages on diabetes management. The significant increase in self-awareness in these areas is supported by research showing that video-based educational interventions can improve patients' knowledge and attitudes towards important aspects of diabetes management, such as adherence to insulin use [27] and general knowledge of the disease [28]. Moreover, extant research has demonstrated that mobile phone-based video media can contribute significantly to improved diabetes management, especially through increased patient engagement with the technology [29].

The stronger influence of animated videos in coastal areas can be understood through Orem's (2001) Social Health Theory, which emphasises the importance of self-awareness in health management [30]. In urban areas, where patients have greater access to educational resources, the impact of animated videos was found to be less significant than anticipated, particularly in comparison to coastal regions that possess a paucity of health education resources. Research by Ady et al. (2024) demonstrated that animated videos not only increased knowledge but also facilitated a more profound comprehension of practical diabetes management. This finding suggests that visual media is an effective tool in enhancing patient comprehension, particularly in contexts with constrained access to health information[31].

This finding is also in line with Bandura's *Teori Pembelajaran Sosial* (Social Learning Theory) (1977), which explains that learning through observation and modelling (examples of behaviour shown in videos) allows patients to learn and adapt better healthy behaviours in their daily lives. Bandura suggests that using visual media such as videos allows patients to see and practice healthy behaviours that can be applied in their lives, thus increasing the success of diabetes management [32], [33]. It is also supported by other studies, which show that educational videos can influence patients' preferences for glucose monitoring technology and improve their decisions in diabetes management [34].

However, despite the animated videos being found to be effective in increasing self-awareness, the low R Square value (between 0.04 and 0.10) indicates that the effect of the videos is still relatively weak. This finding suggests that other factors, such as social support, motivation, and environmental factors, may also play a significant role in enhancing the effectiveness of animation video-based interventions. This finding is corroborated by other studies, which have demonstrated that self-care education programmes can enhance blood sugar management by increasing the knowledge, attitude and self-care behaviour of diabetic patients [35]. Furthermore, it is important to note that patient engagement with technology is a key factor in the success of video-based interventions. It has been hypothesised that eHealth technologies, including mobile phone applications and video games, have the capacity to enhance diabetes management through nutrition and physical activity monitoring. This, in turn, has the potential to facilitate more effective patient behaviour change [36].

In terms of practical implementation, these findings suggest that animated videos can be used as an effective educational tool for patients with type 2 diabetes in areas with limited access to health information. Animated video-based

interventions have the potential to contribute to a comprehensive health education programme, with the objective of enhancing diabetes management, particularly in coastal regions characterised by constrained access to information. It is recommended that the government and health agencies give due consideration to the introduction of animated video-based interventions in hard-to-reach areas, such as through the distribution of educational videos via mobile phones or community television. As demonstrated in previous research, the use of culturally tailored educational videos has been shown to enhance health literacy, self-care practices and clinical outcomes in patients with diabetes in Nepal. This emphasises the significance of customising video-based approaches to optimise the efficacy of health education [37].

Thus, these findings confirm that animated videos are not only an educational tool, but also a highly relevant tool to improve diabetes management, especially in areas with limited information and access to health education. Animated videos were shown to improve health literacy, provide a deeper understanding of diabetes management, and motivate patients to take further steps in treating their condition.

5. CONCLUSION

The present study demonstrates that animated videos have a significant positive effect in increasing patients' self-awareness of blood sugar management, although the effect varies between regions. In urban areas such as Pekanbaru and Pelalawan, animated videos proved to be effective, though not significant in Siak. In contrast, the coastal regions of Dumai, Bagan and Bengkalis exhibited a more consistent effect. Despite the efficacy of animated videos being demonstrated, the low R Square value indicates that other factors, such as social support and motivation, also influence their effectiveness. Consequently, technology-based interventions must be integrated with alternative approaches to ensure optimal outcomes. It is recommended that governmental and health institution bodies consider the integration of animated video-based interventions within health education programmes, with a particular emphasis on regions characterised by constrained access to health-related information. The dissemination of educational videos through mobile phones or community television has been demonstrated to improve health literacy in coastal and remote areas.

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