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The Effect of Early Self-Detection of Diabetes Mellitus on the Healthy Behavior of DM Risk Groups Based on Health Belief Model (HBM)

Agus Priyanto, Eko Dian Hadi Suprayetno, [CA]Titik Juwariah, Jovi Sulaiman
STIKes Ganesha Husada Kediri, Indonesia
[CA]Corresponding Author

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Abstract

Diabetes mellitus is a health problem throughout the world, and its prevalence continues to increase every year. Diabetes mellitus is often not realized by diabetics because it does not produce typical symptoms in the early period. Diabetes is a non-communicable disease (NCD) because of 80% unhealthy behavior. The problem in this research is that the diabetes risk group cannot yet carry out independent early detection of diabetes; they are not aware of their health conditions related to the incidence of DM, so they have not made efforts to change behavior to prevent diabetes mellitus and reduce risk factors that can be changed. This research aimed to determine the effect of early self-detection of diabetes mellitus on the health behavior of DM risk groups based on the Health Belief Model (HBM). This quantitative research used a quasi-experiment design with a one-group pre-post-test approach. The sample was 100 respondents by purposive sampling. The data collection used questionnaires based on HBM. The research intervention was by teaching the use of the SEDAB application and educating on healthy behavior to prevent DM; the interval between intervention and post-test was 4 weeks. Analysis of research data uses the Wilcoxon Signed Rank Test. The research results show that the intervention has the effect of increasing perceived susceptibility (p-value=0.000), Perceived Severity (p-value=0.000), Perceived Barriers (p-value=0.000), Perceived Benefit Perceived (p-value=0.000), cues to action (p-value=0.017), Self-efficacy (p-value=0.000), and healthy behavior (p-value=0.000). Early detection of diabetes in diabetes risk groups is essential to prevent DM and improve healthier lifestyles.

✉Correspondence Address:
STIKes Ganesha Husada Kediri – East Java, Indonesia
Email: titik.juwariah@gmail.com
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INTRODUCTION

Diabetes mellitus is a health problem throughout the world; its prevalence continues to increase every year. Diabetes mellitus is often not realized by diabetics because it does not produce typical symptoms in the early period (1,2). DM is a non-communicable disease (NCD), and 80% lead to unhealthy behavior, including 33.5% lack of physical activity, 95.5% of the population aged >10 years do not consume fruit and vegetables as much as 33.8% (Priyanto & Suprayetno, 2022; Riskesdas, 2018).

Prediabetes represents a transitional stage between normal blood sugar levels and diabetes, with high prevalence, particularly among older adults and those with obesity. Currently, five definitions of prediabetes are in use, each based on varying thresholds for HbA1C, fasting glucose, and 2-hour glucose levels (Echouffo-Tcheugui & Selvin, 2021). About a third of the adult population in Indonesia shows signs of pre-diabetes in the form of impaired fasting glucose and impaired glucose tolerance. The proportion of undiagnosed diabetes is higher and similar rates in individuals with pre-diabetes (Riskesdas, 2018; Tanoey & Becher, 2021). Research in Indonesia has reported several known risk factors for diabetes, including overweight and obesity, smoking, living in urban areas, and low education (Tanoey & Becher, 2021).

Low public knowledge influences attitudes and behavior toward early detection of diabetes. The public's healthy perception of health can hinder the behavior of having regular health checks at health services. Posbindu PTM (Integrated Guidance Post for NCDs) is Indonesia's community-based program which was aimed to mitigate the impact of NCDs through monitoring risk factors and empowering individuals for early intervention and lifestyle changes (Nastiti et al., 2024). Early Detection of Non-Communicable Diseases (NCD) was done by the Community Health Center, but its achievements were not optimal. Several risk factors for DM actually already exist in the community, without realizing it, they have entered the category of Prediabetes mellitus, but they are not aware of it (Priyanto et al., 2022).

The Preliminary study was done on 10 members of RT.1 Mojoroto, they had risk factors such as 50% obesity, 30% a family history of DM, and 20% had these 2 risk factors. They said they had never checked their blood sugar levels and felt fine. When random blood sugar levels were checked, 40% showed blood sugar levels >150 mg/dl.

Lifestyle changes can reduce diabetes risk in individuals with prediabetes, but the effects of simply notifying people of their prediabetes status on blood sugar or health behaviors remain uncertain. The effect of newly recognizing prediabetes on blood sugar trends in individuals who were previously normoglycemic is not well understood, and cross-sectional studies provide inconsistent findings on how this awareness influences self-initiated health behaviors (Owei et al., 2019). Recognizing prediabetes and understanding its risks can motivate individuals at risk of type 2 diabetes to consider lifestyle changes, but this awareness alone often doesn't result in action. The factors that enable or hinder lifestyle changes are complex and operate across multiple levels, including personal, social, environmental, and policy influences (Skoglund et al., 2022).

The problem in this research is that the DM risk group cannot yet carry out independent early detection of DM; they are not aware of their health conditions related to the incidence of DM, so they have not made efforts to change behavior to prevent DM and reduce risk factors that can be changed. This research aims to determine the effect of early self-detection of diabetes mellitus on the healthy behavior of DM risk groups based on the Health Belief Model (HBM) theory. The specific aim is to identify perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among diabetes risk groups.

Therefore, early detection of DM in DM risk groups is necessary to prevent DM and improve healthier lifestyles. The Health Belief Model (HBM) is often used in the context of disease prevention and management, including diabetes. This theory provides a framework for understanding individuals' health behavior based on

their beliefs about disease and available prevention efforts.

METHODS

This quantitative research used a quasi-experiment design with a one-group pre-post-test approach. The sampling technique in this research used purposive sampling, 100 respondents. The data was collected by using research questionnaires before and after the intervention. The intervention taught people how to use the SEDAB application and educated them on healthy behaviors to prevent DM. The interval between intervention and post-test was four weeks interval research data. Research data analysis uses the Wilcoxon Signed Rank Test.

RESULTS

Table 1. Characteristics Respondent

No	Data	Frequency	Prosentage (%)
1	Age		
	Early Adulthood	9	9
	Late Adulthood	30	30
	Early Elderly	30	30
	Late Elderly	25	25
	Seniors	6	6
2	Gender		
	Man	43	43
	Woman	57	57
3	Education		
	Elementary	17	17
	Middle school	20	20
	High school	38	38
	Diploma/ S1	22	22
	Magister	2	2
	Doctor	1	1
4	Family Income		
	<1 million	8	8
	1-3 million	49	49
	>3 million	43	43
5	Job		
	Government employees	4	4
	Private job		
	Trader	19	19
	Farmer	15	15
	Laborer	7	7
	Housewife	20	20
	Self-employed	24	24
	Retired	6	6
		5	5
6	Children		
	Zero	7	7
	One	26	26
	Two	38	38

No	Data	Frequency	Prosentage (%)
	Three	24	24
	Four	5	5
7	Diabetes Family History		
	Yes		
	No	64	64
		36	36
8	Body Mass Index		
	Under weigh	7	7
	Normal	25	25
	Over weigh	12	12
	Grade 1 Obesity	27	27
	Grade 2 Obesity	29	29
9	Diabetes criteria		
	Not Diabetes	57	57
	Prediabetes	41	41
	Diabetes	2	2

Based on the characteristics of the respondents, most of them were late adulthood and early elderly, 30%; more than half were female, 57%; most had a high school education, 38%; almost half had a family income of 1-3 million, 49%, the majority respondents are housewives, 24%, most with two children, 38%, more than half have a family history of diabetes, 64%, most with a body mass index are in the grade 2 obesity category, 29%, and more than half of the respondents with blood sugar levels at any time indicated that they were not diabetes, 57% and 41% were pre-diabetes.

Table 2. Statistic Descriptive Research Variables

	Minimum		Maximum		Mean		Std. Deviation	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Perceived susceptibility	10	10	18	20	15.14	16.31	1.621	2.029
Perceived severity	11	12	15	16	12.81	14.12	.873	.967
Perceived benefits	11	11	14	15	12.22	12.65	.660	.857
Perceived barriers	9	11	15	16	12.44	13.68	1.748	1.171
Cues to Action	8	8	13	13	10.65	10.82	1.306	1.104
Self-efficacy	9	10	14	14	11.14	11.84	.725	1.022
Health behaviors	14	22	26	33	19.46	26.90	3.386	2.402

Based on Table 2, the variables perceived severity, perceived barriers, self-efficacy, and health behaviors experienced a minimum increase in value from pre- to post-test. The maximum values of the variables perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and health behaviors increased from pre- to post-test. Meanwhile, in the average value, all HBM model variables experienced an increase from pre to post-test.

Table 3. Result of Statistict test With Wilcoxon Signed Rank Test

	Z	p-value
Post – Pre test Perceived susceptibility	-7.093[b]	.000
Post - Pre test Perceived severity	-7.729[b]	.000

Post - Pre test Perceived benefits	-5.301[b]	.000
Post - Pre test Perceived barriers	-6.608[b]	.000
Post - Pre test Cues to Action	-2.380[c]	.017
Post - Pre test Self-efficacy	-6.037[b]	.000
Post - Pre test Health behaviors	-8.694[b]	.000

Based on the results of statistical tests with the Wilcoxon Signed Rank test, it shows that the intervention influences all research variables with a p-value <0.05, which means that there is an increase in perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among risk factor diabetes group.

DISCUSSION

Pre test perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among diabetes risk groups

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by high blood glucose levels resulting from defects in insulin production, action, or both. Diabetes is a growing global health problem, with the fastest growth rates occurring in low- and middle-income countries. Some risk factors include reduced physical activity, sedentary lifestyles, and aging, which make people more likely to develop diabetes (Melkamu et al., 2021). The research results show that the minimum, maximum, and average values for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among diabetes risk groups, the pre-test values are lower than the post-test.

Perceived susceptibility: assessing the probability of acquiring an illness or encountering an undesirable outcome. Perceived severity: understanding the seriousness of the disease, condition, or unfavorable outcome and what could happen without additional action. There is a considerable range in how people perceive the severity of an illness, and they often consider both the medical and social implications when assessing its severity. Perceived benefits: the effectiveness of various available actions to reduce the risk of illness are perceived. Perceived barriers: obstacles to performing a recommended health action. Self-efficacy is an individual's belief in their ability to effectively perform a specific behavior or task. It is also related to the likelihood of a person engaging in a desired behavior. Cues to action: whether from one's surroundings or subjective experiences. Specific cues can influence the actions one chooses to take. While less explored, cues to action are the stimuli that initiate the decision-making process to embrace a recommended health intervention. These cues can be either internal or external, from noticing symptoms of an illness to being exposed to a health campaign (Alyafei & Easton-Carr, 2024).

This research aligns with other research that analyzes the behavior of diabetes risk groups in diabetes prevention. The results of diabetes mellitus prevention behavior from perceptions of susceptibility (family disease), perceptions of severity (psychological response), perceptions of barriers (busy work), perceptions of cues to action (sugar diet, exercise, consumption of herbal and medical drugs), perceived benefits (behaviors in the prevention of diabetes mellitus). The conclusion is that there are barriers to preventive behavior, especially in physical activity; this is due to busy work, so the participants are not regular in exercising (Nurhidayah et al., 2020). Other research found that 59 (59%) respondents need to be more obedient in physical activity. Most of the respondents were female (66%), had a primary - secondary education category (93%), and had a work category (56%). Most of the respondents belonged to the average age category that was less than equal to 55 years old (57%). The results showed that dependent variable related to age (p = 0.000), gender (p = 0.034), work (p = 0,000), perceived barriers (p = 0.020), self-efficacy (p =

0.000), family support (0,000), health worker support (p=0,000). Most physical activities comply among pre-diabetics in the category of disobedient. The Health Belief Model (HBM) can explain non-compliance with pre-diabetes in carrying out prevention of diabetes mellitus through perceived barriers (perceived barriers). in controlling the prevention of diabetes mellitus, perceived benefits in implementing disease prevention, the perception perceived susceptibility of the disease, perceived severity perceived severity of the disease (Zakiyyah et al., 2019).

The results of the study showed an increase in the value of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and health behavior after respondents conducted early detection of diabetes mellitus independently. This shows that the results of early detection of diabetes mellitus independently increase respondents' knowledge about their current health conditions, then knowledge influences perceptions of the disease, awareness of the degree of vulnerability and influences the intention to take preventive action against more severe conditions. In the HBM theory, perceptions and intentions influence whether someone at risk for diabetes takes preventive actions or avoids them.

Post Test perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among diabetes risk groups.

The research results show that the minimum, maximum, and average values for perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among diabetes risk groups, the post-test values are higher than the pre-test.

The greater the perceived susceptibility, the greater the possibility of engaging in behavior to reduce risk. So, facing this requires encouragement to change health behavior according to perceived vulnerability. The medical information or knowledge is the basis of Perceived severity. It can also come from the belief that someone will encounter difficulties due to illness and will create or affect his life in general. Likewise with this theory, in groups, these respondents required deep effort to provide counseling or education health to improve information so it will have an impact on confidence respondents will experience difficulties when does not change health behavior true and correct (Kurnia & Suprihatin, 2017). Perceived benefits are statements that are subjective and have positive value towards the individual so the individual adopts the behavior. The greater the perceived benefits, the greater the motivation for the individual to adopt the behavior. Perceived benefits relate to DM patient compliance and healthier behavior; in the Health Belief Model (HBM), the possibility of an individual taking action prevention depends on the outcome of two beliefs or health assessment, namely, the perceived threat from pain and considerations about benefits and loss (Nurhidayah et al., 2020).

Regarding the changed behavior, one must believe that the benefits of the new behavior are more significant than the consequences of continuing the behavior long, obstacles in the future, and adopting the new behavior; a person with the perception of barriers will feel to be an element that is significant in determining whether there is a behavior change. The cues to action are events, people, or things that move people to change their behavior. Cues for this action can come from information from mass media, advice from people's surroundings, personal or family experiences, articles, etc. Perceived benefits: people tend to adopt healthier behavior when they believe that new behavior will reduce the risk of having a new disease (Kurnia & Suprihatin, 2017).

The Effect of Early Self-Detection of Diabetes Mellitus by SEDAB Apllication on the Healthy Behavior of DM Risk Groups Based on Health Belief Model (HBM)

Prediabetes is a condition of impaired glucose metabolism marked by elevated blood sugar levels that fall short of a diabetes diagnosis. It carries a heightened risk of cardiovascular disease, with macrovascular issues beginning in this phase.

Early screening and diagnosis are crucial to preventing diabetes and its complications (Cosic et al., 2023). Modern technologies have the potential to enhance the effectiveness of these interventions, support metabolic health, and facilitate large-scale prevention of type 2 diabetes (Zahedani et al., 2023). Type 2 diabetes can be prevented through dietary and lifestyle changes during the prediabetes stage. Digital technology supports individuals in delaying or preventing diabetes by encouraging self-care and promoting behavior changes that improve health (Subramaniam et al., 2021). HBM can improve enrollment in the National Diabetes Prevention Program (DPP) among adults with prediabetes, it's essential to identify individuals with the condition, boost their awareness of the diagnosis, enhance the perceived advantages of joining, and offer clear prompts to take action (Joiner et al., 2022).

Early detection of DM in DM risk groups is necessary to prevent DM and improve healthier lifestyles. The intervention influences variables on HBM with a p-value <0.05, which means that there is an increase in perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues for action, self-efficacy, and health behaviors among risk factor diabetes group.

The results of the study stated that the perception based on health belief model (HBM), perception of vulnerability is obtained from hereditary factors, family disease, perception seriousness related to the risk of amputation due to DM, as well there is a psychological response felt by participants such as anxiety and fear due to DM, perception of internal obstacles DM prevention behavior related to busy work and taking care of household chores, perceptual cues to action about sugar diet, exercise, and consumption of herbal and medical medicines, perception of related benefits behavior in prevention DM. Research related to perceptions of barriers to prevention Particularly, participants felt strongly about DM in sports and physical activity. The reason is that the participants are busy with work and do not plan sports (Nurhidayah et al., 2020). Younger individuals with higher education and knowledge feel that vulnerability and perceived severity can carry out preventive behavior more efficiently. Perceived obstacles, including physical, mental, or financial barriers, hinder accurate health behaviors. At the moment research, participants with moderate and reasonable economic status had perceptions of severity and level of knowledge. Previous research findings also show that environmental factors, such as inappropriate habits, poverty influence the prevalence of chronic disease disorders such as type 2 diabetes, and weak socioeconomic status (Afrasiabi et al., 2022). In this study, the majority were in late adulthood and early elderly, more than half were female, the highest level of education was high school, and most of the family income was 1-3 million/per month. More than half had a family history of diabetes, body mass index of grade 2, obesity, and blood sugar, indicating pre-diabetic status. The factors mentioned above may lead to applying the health belief model.

Participants aware of their prediabetes status were more likely to recognize a risk of diabetes and view themselves as overweight, yet this awareness did not translate into changes in diet or physical activity. While awareness of prediabetes increased perceived diabetes risk, it did not lead to greater health behavior engagement. Future research could explore how elements of the health belief model influence health behaviors in individuals with prediabetes (Li et al., 2021). Several components contained in the HBM concept can grow confidence from diabetic to behave healthy so you can control it diabetes and its complications (Megawaty & Syahrul, 2019).

The application of SEDAB in early detection of diabetes mellitus has been proven effective in preventing DM. Increased perception of disease susceptibility is associated with patient compliance and healthier behavior. By knowing the risk of DM from existing symptoms, patients feel threatened so that they will take preventive measures such as complying with diet, exercise and rest as needed. In the Health Belief Model (HBM), the possibility of individuals taking preventive measures depends on the results of two beliefs or health assessments,

namely perceived threats and considerations of benefits and losses.

CONCLUSION

The intervention on early detection of diabetes with SEDAB had an impact on the health behavior of diabetes risk groups based on HBM by increasing perceived susceptibility (p-value=0.000), Perceived Severity (p-value=0.000), Perceived Barriers (p-value=0.000), Perceived Benefit Perceived (p-value=0.000), cues to action (p-value=0.017), Self-efficacy (p-value=0.000), and healthy behavior (p-value=0.000).

SUGGESTION

Further researchers are expected to conduct a trial of the SEDAB Application for early detection of diabetes mellitus on a wider audience to determine the effectiveness of the application in screening diabetes Mellitus.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest in the research.

AUTHOR CONTRIBUTIONS

Agus Priyanto is responsible in the conceptualization, data curation, formal analysis, methodology, validation, writing the original draft, and resources. Eko Dian Hadi Suprayetno works in the investigation, methodology, validation, collecting data. Titik Juwariah is in charge in the reviewing and editing process. Jovi Sulaiman is responsible in collecting the data, resources, and investigations.

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