

Health Literacy Brisk Walking Exercise on Clinical Outcomes of Blood Sugar in Patients with Type 2 Diabetes Mellitus in Indonesia

Zainuddin^{1,2}, Andi Zulkifli Abdullah^{2,*}, Nurhaedar Jafar³, Suriah⁴, Nursalam⁵, Darmawansyah⁶, Syahrul Syahrul⁷, Wahiduddin⁸, Widiatoro⁹, Anwar Mallongi¹⁰

Zainuddin^{1,2}, Andi Zulkifli Abdullah^{2,*}, Nurhaedar Jafar³, Suriah⁴, Nursalam⁵, Darmawansyah⁶, Syahrul Syahrul⁷, Wahiduddin⁸, Widiatoro⁹, Anwar Mallongi¹⁰

¹Department of Public Health, Doctoral Student of Public Health, Hasanuddin University, Department of Nursing, STIKes Tanawali, INDONESIA.

²Department of Epidemiology, Faculty of Public Health, Hasanuddin University, INDONESIA.

³Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, INDONESIA.

⁴Department of Health Promotion, Faculty of Public Health, Hasanuddin University, INDONESIA.

⁵Department of Nursing, Faculty of Nursing, Airlangga University, INDONESIA.

⁶Department of Health Administration and policy study program, Faculty of Public Health, Hasanuddin University, INDONESIA.

⁷Department of Nursing, Faculty of Nursing, Hasanuddin University, INDONESIA.

⁸Department of Epidemiology, Faculty of Public Health, Hasanuddin University, INDONESIA.

⁹School of Health sciences Santoo Borromeus, INDONESIA.

¹⁰Department of Environmental Health, Faculty of Public Health, Hasanuddin University, INDONESIA.

Correspondence

Andi Zulkifli Abdullah

Department of Epidemiology, Faculty of Public Health, Hasanuddin University, INDONESIA.

E-mail: zulkifliabdullah@yahoo.com

History

- Submission Date: 21-02-2023;
- Review completed: 29-03-2023;
- Accepted Date: 04-04-2023.

DOI : 10.5530/pj.2023.15.68

Article Available online

<http://www.phcogj.com/v15/i6>

Copyright

© 2023 Phcogj.Com. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International license.



ABSTRACT

Background: Regular Physical activity (PA) is recommended for patients with type 2 diabetes because it has a beneficial effect on metabolic risk factors for the development of diabetic complications. This study was designed to determine the effect of health literacy (HL) brisk walking on clinical outcomes (HbA1c) and PA in patients with DMT2. **Method:** In using the Quasi Experimental method using the Two group pre-posttest design approach. Research subjects were allocated for the provision of Health literacy Brisk walking (n=30, 30 completed) and the usual care group (n = 30,30 completed). Health literacy brisk walking participants received weekly scheduled information via Whatsapp group with monitoring to walk 3-5 times for 150 minutes/week, while the control group only received regular care from the Chronic Disease Management (Prolanis) program. **Results:** Sixty T2DM patients (thirty in the intervention group and thirty in the control group) were examined. The results showed that Health literacy Brisk walking with Whatsapp Group Monitoring in the intervention group was significantly higher than usual care from the Chronic Disease Management program (Prolanis) in the control group towards changes in HbA1c and PA after 3 months (p<0.05). **Conclusion:** Health literacy brisk walking related to diabetes can be a modifiable factor related to HbA1c for DMT2 patients. The findings indicate the need for health care providers to be able to consider brisk walking PA as a solution in controlling blood sugar (HbA1c).

Key words: Health Literacy Brisk walking, Physical Activity, DMT2, Blood Sugar (HbA1c).

INTRODUCTION

Diabetes Mellitus Type 2 (DMT2) is a chronic metabolic disorder characterized by persistent hyperglycemia and abnormal carbohydrate metabolism due to the body's inability to produce and even respond to insulin.^{1,2} Diabetes mellitus is a chronic disease that is very dangerous, with a prevalence that continues to increase worldwide, around 463 million adults are diagnosed with diabetes by predicting that in 2045 there will be an increase of 51% or about 700 million people diagnosed with diabetes.^{3,4} DMT2 is the most common type of diabetes, around 90%-95% of all diabetes cases. The most common risk factors for DMT2 are increasing age, increased BMI, and Physical Activity (PA).⁵⁻⁷

PA defined exercise is considered a cornerstone in the treatment of DMT2.⁸⁻¹² PA has been recognized as the cornerstone for preventing DMT2, unfortunately most people with DMT2 have irregular PA.^{13,14} Regular PA is recommended for patients with type 2 diabetes because it has a beneficial effect on metabolic risk factors for the development of diabetic complications.¹⁵⁻¹⁸ One-time exercise lowers circulating blood glucose concentrations and reduces the prevalence of hyperglycemic episodes throughout the following day in patients with DMT2.^{19,20}

Previous studies have reported that increasing PA has been shown to be effective and can increase metabolism and in controlling blood sugar levels.²¹⁻²⁵ The PA recommended by the American

College of Sports Medicine and the American Diabetes Association is 150 minutes per week and additional resistance training at least 2-3 days per week in parallel with pharmacological treatment.²⁶⁻²⁷ However, epidemiological studies show that most patients are inactive, with only 23-37% of patients reaching the recommended exercise levels in the US, 21% in Canada, and 15.3% in mainland China.²⁸⁻³⁰

Although some evidence supports the importance of PA, the majority of DMT2 patients in Indonesia do not meet the established guidelines. Previous research²⁰ has shown that 89.3% of Indonesian participants had a low PA level and 58.9% of Indonesians had a habit of more than 3 hours of sedentary activity per day which could affect the patient's inability to carry out coordinated PA.

Strategies have been widely implemented and proposed to increase the adoption and maintenance of PA in T2DM patients. and proposed to increase the adoption and maintenance of PA in DMT2 patients. However, there are still large gaps regarding the best suitable PA intervention that can directly maximize glucose control and be maintained in the long term. In recent years, new interventions have been designed with a focus on HL of diabetic patients, namely, how the patient's ability is to be able to obtain, understand, and communicate the basic information needed to make an informed decision regarding their health.³¹ HL-oriented interventions have been observed and prioritized to be able to effectively improve glycemic control status by maintaining and improving self-management behaviors.^{32,33}

Cite this article: Zainuddin, Abdullah AZ, Jafar N, Suriah, Nursalam, Darmawansyah, et al. Health Literacy Brisk Walking Exercise on Clinical Outcomes of Blood Sugar in Patients with Type 2 Diabetes Mellitus in Indonesia. Pharmacogn J. 2023;15(2): 433-438.

In this study, the level of HL not only provides information on the patient's ability to obtain, understand the importance of PA through the brisk walking module, but DMT2 patients will be improved by an intervention that focuses on brisk walking exercises with the media brisk walking module through monitoring through the WhatsApp (WA) group. To evaluate the level of PA enhanced by the HL intervention, and the effect on PA (MET-Minute/Week) and HbA1c, precisely will try a cluster randomized control trial (RCT) in takalar Regency, Indonesia with an experiment to design an intervention that maximizes how to control blood sugar.

MATERIAL AND METHODS

Study design and subject

This study was designed with a quasi-experimental method using a two-group pre-posttest design approach to evaluate the effectiveness of HL brisk walking on clinical outcomes (HbA1c) in DMT2 patients. The intervention focused on HL Brisk walking by monitoring the WA Group and the HL Brisk walking group without monitoring. In short, 2 Public Health Centre (PHC) in Takalar Regency were easily selected from a total of 8 phc All locations met the criteria by considering: 1) The effectiveness of the prolanis program from the PHC to facilitate the recruitment of respondents. At least 30 patients can be recruited per location 2) Nurses holding prolanis programs at each location can participate in the intervention; 3) agreed to participate for 3 months of the study. A total of 60 DMT2 patients were recruited from 2 PHC locations during the period April-September 2022. Inclusion criteria for participants included a clinical diagnosis of DMT2, HbA1c 7% (preferably the last 3 months), Willing to be a respondent by signing an informed consent and willing to fill out a questionnaire, not there is a history of major surgical procedures in the previous 5 months or planning of any major surgical procedures in the next 5 months, Patients with DMT2 on oral and injection medication and patients who do not experience cognitive impairment. Patients were excluded if they had a medical condition that prevented them from walking for 15 to 30 minutes a day.

The ethical approval was obtained from the Ethics Committee of the Faculty of Public Health, Hasanuddin University, Number: 3179/UN4.14.1/TP.01.02/2022.

Intervention

The control group received the usual care from the Indonesian prolanis program which included clinical examination of blood sugar, prolanis exercise and the provision of existing health literacy at the discretion of each PHC holding the program.

Patients in the HL brisk walking group received HL through the HL brisk walking module regarding the importance of brisk walking and were asked to do brisk walking PA 3-5 times a week for a total of 150 times/week.³ In addition, DMT2 patients are expected to join the WA group and record the frequency, time, and report in the WA group the brisk walking activities they do for monitoring purposes.

The brisk walking Educational Module includes information on the concept of DM, diabetes self-management such as diet, exercise, foot care, glucose monitoring, drug management. More specifically, the brisk walking education module covers the importance of brisk walking with the American College of Sports Medicine and American Diabetes Association recommendations for PA of 150 minutes per week. The Indonesian version of the material is sent through the WA group and visits 1-2 times a month with 5 to 10 minutes per time. At each visit, they were asked to evaluate each module material and the obstacles faced by the patient.

Before starting the HL intervention, patients were collected for about 2-3 hours of education about diabetes management, introduction to

the brisk walking education module. The pre-education process was carried out by distributing HL questionnaires for pre-health literacy assessment.

Data collection and Health Literacy assessment

Information on demographic characteristics of diabetes diagnosis based on primary data from Public health Center. HbA1c levels were measured at the beginning of the first month.

HL and Brisk walking intervention focused on Exercise specifically designed to increase PA levels by recommending activities in the morning daily life of DMT2 patients, we assessed PA levels using the IPAQ PA questionnaire using the MET (Metabolic equivalents of task)³² and is reserved for running specific IPAQs.³⁴

Statistical analysis

The description starts from Univariate analysis: The description of the characteristics of the respondents used in this study includes the distribution of respondents by sex, age, education, occupation, duration of diabetes mellitus, and treatment. Continuous variables are presented in terms of mean and standard deviation (SD) or Median and IQR ranges while categorical variables are presented in terms of frequency and percentage. While the variable 2 intervention groups used the T-Test test based on the results of the normality test showing the data to be normally distributed. All analyzes were performed using IBM SPSS Statistics 21.

RESULTS

Of the total 62 study participants, complete data were available for 60 patients (96.7%) at the end of the intervention (3 months). Table 1 shows the baseline characteristics of all participants from the intervention status.

Based on table 1, shows that the characteristics of respondents based on gender indicate that the group with the most DMT2 sufferers is the group with the female sex. In the intervention group Health literacy Brisk walking, there were 23 women (77%) and in the treatment group there were 25 people (83.3%).The education of respondents in

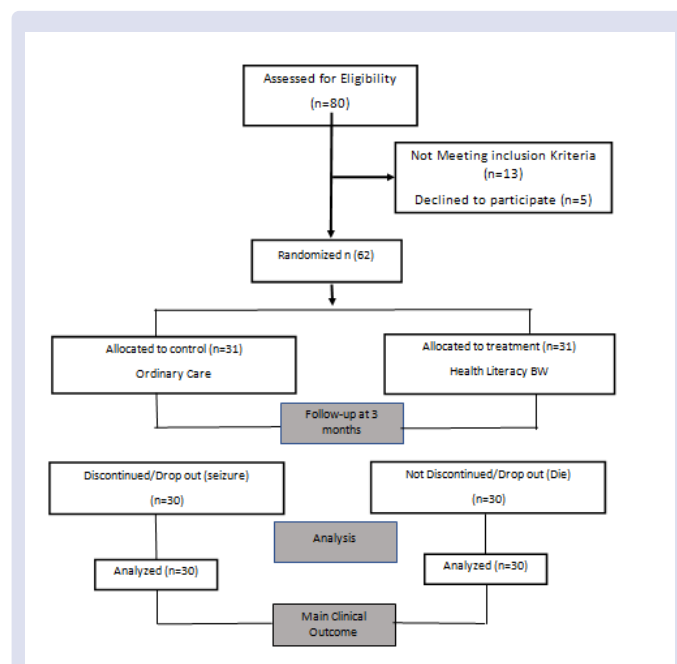


Figure 1: BW health literacy intervention group, ordinary care control group

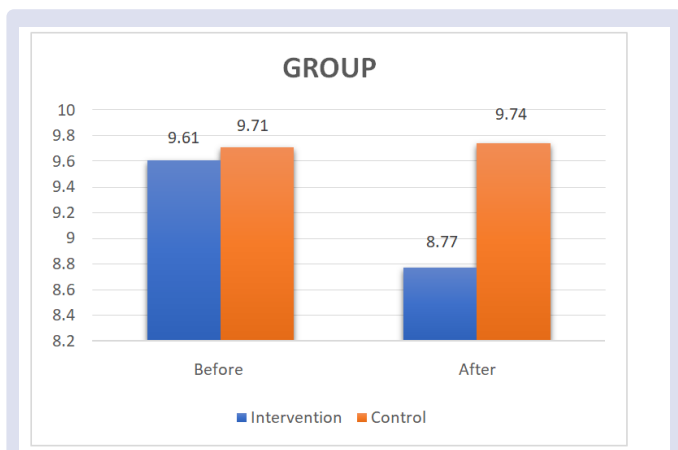


Figure 2: Comparison of changes in mean HbA1c before and after the intervention group and the control group

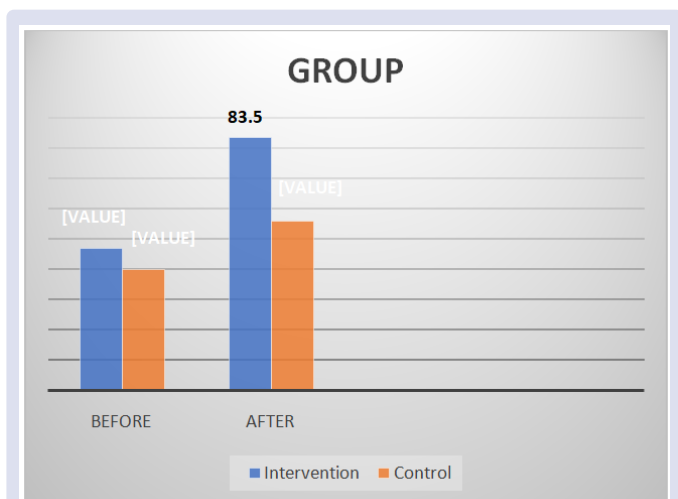


Figure 3: Comparisons of changes in mean (PA-Minutes/Week) before and after intervention group and control group

the health literacy brisk walking group at the high school/high school education level was 13 people (43.3%), and in the ordinary care group only 6 people (20.1.3%) The distribution of the work of respondents in the health literacy brisk walking group and ordinary care varied more with the employment data in the intervention group, most of the jobs were retirees with 8 people (26.6%) while in the usual care group, there were more in the IRT category with 12 people (39.7%). The duration of suffering from DMT2 in the intervention group Health Literacy brisk walking and the usual care group found more respondents who suffered from DMT2 ≥ 5 years, namely 23 people (77%) in the intervention group and in the usual care group, there were more sufferers ≥ 5 years, namely as many as 21 people (70%) For the treatment of respondents in the 2 groups showed more respondents who used oral drugs as many as 15 people (50%) in the Health Literacy Brisk walking group and in the usual care group, namely 21 people (70.0%).

Regarding HL Brisk walking at the HbA1c level there is a significant difference in the 2 groups having a statistically significant value.

Analysis using the T-test was significant in the intervention group (p=0.001) and the value was not significant in the control group (p=0.904). The mean value of HbA1c before being given treatment was 9.61 with a standard deviation of 2.23 and the mean value of HbA1c after being given treatment was 8.77 with a standard deviation of 1.86, meaning that there was a decrease in HbA1c after being given HL Brisk

walking in the intervention group in DMT2 patients. And the mean value of PA (MET=Minutes/week before being given treatment was 47.133 with a standard deviation value of 36.8405 and the mean value of PA (MET=Minutes/week) after being given treatment was 83.50 with a standard deviation of 30.994 meaning that there was a change in PA (MET-Minutes/week) after being given HL Brisk walking in the intervention group in patients with DMT2.

This shows that the provision of Brisk walking HL through the media of brisk walking education module with WA group monitoring can reduce HbA1c and increase PA (MET-Minutes/week).

DISCUSSION

In data analysis in Takalar DMT2 patients, Indonesia we compared the effectiveness of HL Brisk walking with usual care through a prolanis program by evaluating the effect on HbA1c and PA (MET-Minutes/week) at the start of our intervention meeting the Exercise guidelines

Table 1A: Basic characteristics of research participants.

Variable	n	Min	Max	Mean	Std Deviation
Age intervention group	30	31	69	56.13	9.145
Age control group	30	50	79	58.73	6.772

Table 1B: Basic characteristics of research participants.

Characteristic	Group		Group	
	Intervention	Control	Intervention	Control
	n	%	n	%
Sex				
Women	23	77	25	83,3
Man	7	23	5	16,7
Total	30	100	30	100
Education				
Never went to school	0	0	3	10
Did not finish elementary school	0	0	3	10
Elementary school	1	3,5	5	16,6
Junior high school	5	16,6	6	20,1
Senior high school	13	43,3	6	20,1
Diploma	2	6,6	2	6,6
University	9	30	5	16,6
Total	30	100	30	100
Occupation				
Not working	8	26,6	6	20,1
PNS/TNI/Polri/BUMN/BUMD	5	16,6	5	16,6
Private employees	2	6,6	0	0
Entrepreneur	3	10	1	3,4
Farmer	0	0	2	6,6
Fisherman	0	0	0	0
Laborer/Driver/Housewife	4	13,6	12	39,7
Retired	8	26,6	4	13,6
Total	30	100	30	100
Period had DM				
≤ 5 years	7	23	9	30
≥ 5 years	23	77	21	70
Total	30	100	30	100
Medication				
Oral	15	50	21	70
Injection	11	22,8	7	23
Oral/injection	4	13,6	2	3,6
Total	30	100	30	100

Table 2: Distribution of HbA1C control and physical activity in patients with DMT2.

Intervention Group				
Variable		n	Mean	Std. Deviation
HbA1C	Pre IG	30	9,613	2, 235
	Post IG	30	8,776	1,869
Days-PA	Pre IG	30	5,467	2,096
	Post IG	30	7,00	0,000
PA-min/week	Pre IG	30	47,133	36,84
	Post IG	30	83,50	30,99
MET-Total min/week	Pre IG	30	750,85	721,9
	Post IG	30	1826,2	714,8
Control Group				
HbA1C	Pre CG	30	9,716	1,960
	Post CG	30	9,743	1,938
Days-PA	Pre CG	30	1,600	0,674
	Post CG	30	6,87	0,434
PA-min/week	Pre CG	30	40,033	20,34
	Post CG	30	55,90	18,44
MET-Total min/week	Pre CG	30	577,28	423,8
	Post CG	30	894,35	607,0

based on the American College of Sports Medicine and the American College of Sports Medicine. The Diabetes Association recommends at least 150 minutes per week of moderate-intensity exercise such as brisk walking.

Several previous studies looked at the role of exercise intervention in increasing PA levels in DMT2 patients. Several previous research results have observed the role of exercise intervention in lowering HbA1c such as studies conducted³⁵⁻³⁸ reported changes in HbA1c. In addition the results of a meta-analysis by¹⁹ showed an overall decrease in HbA1c of 0.8% with resistance training and an increase of 11.8%. Consistent with this study, we immediately observed changes in PA levels in the HL intervention group and proved that the combination of education through HL Briskwalking with BW module media with supervised exercise-walking (BW)-focused interventions was able to increase PA levels (MET-Minutes/week). in the subject and able to have an impact on changes in HbA1c. In addition, with this study, HL Briskwalking with BW module media with intervention focused on exercise-walking (BW) requires collaboration with patients with monitoring provided, maximum interaction is needed in providing support to DMT2 patients to be able to do physical activities.⁴³⁻⁴⁶ The intervention group was proven by monitoring through the Whatsapp group to be able to produce significant changes in HbA1c changes and an increase in PA (MET-Minutes/week). A meta-analysis study³⁹ explained that PA should include more collaboration and interaction with patients and more effectively refer to behavioral interventions in improving change programs in controlling blood sugar.

Therefore, the importance of continuous and scheduled BW interventions with a combination of HL can be used as material that can be promoted for DMT2 patients to build healthy behaviors with targets for long-term benefits to DMT2 patients. PA is a solution to optimally cope and adapt to diabetes patients in preventing complications and controlling blood sugar.

Several studies that developed HL by developing studies with DSME interventions only⁴⁰⁻⁴² with DSME interventions focused on interventions that were used to evaluate long-term effects, namely 12 months and 18 months. This research develops a curriculum media with a cultural focus. By using the media module, the curriculum with the long-term group based DSME intervention resulted in the

participants showing a decrease in HbA1c. Some of these studies are the basis for combining PA interventions by utilizing HL media. It was proven by the HL study that it was able to significantly decrease and increase the PA intensity (MET-Minutes/week).

Several studies^{41,43,44} explain the same thing in this case, by providing education about self-care behaviors can lower blood sugar. Studies conducted by²⁵ revealed that the promotion of PA is very important and as a basis for action at the individual and population level of DMT2 patients to be able to maintain self-management. Education with the Physical Activity Health module is able to change the behavior of DMT2 patients to be able to carry out activities with information regarding the importance of physical activity in controlling blood sugar. Respondents' ability to control their blood sugar is inseparable from many factors, one of which is the respondent's ability to clearly understand the contents of the given module, the physical activity health module which is designed with information that is easy to understand and integrated with education. image from the Ministry of Health reference regarding the importance of physical activity in controlling blood sugar (HbA1c).

Such promotions are reasonable as a basis action at the individual and population levels.

There was no difference between the HbA1c values in the intervention group and the control group, they both had a significant effect, but if the delta values of each group were compared and statistical testing was carried out, there were significant differences between the intervention group and the control group, which can be seen in table 3. These two results can be interpreted that the provision of Health literacy through the physical activity health module which is directly monitored through the WhatsApp group with the education media of the Prolanis program is more significant in changing the HbA1c value and PA achievement compared to the prolanis program media although basically the use of the prolanis program media can also change HbA1c and PA.

This difference in results occurs because basically every individual needs continuous education on an ongoing basis and is still given attention through monitoring, through WhatsApp groups. Participants will be motivated to do PA and must achieve PA targets through WhatsApp group monitors, Participants will convey *via* chat groups if they have carried out physical activities so that they will indirectly stimulate other participants to do PA. With the results of this study, it can be used as a form of policy in carrying out Indonesian government programs in improving the self-management of DMT2 patients, due to the current educational media that is widely used, namely leaflets which are generally used by health centers cannot answer the demands for education due to the nature of leaflets. which is easily damaged and not durable. The existence of a media module to carry out DM self-management more effectively can meet the patient's need for long-term education related to physical activity which is very supportive in the self-management of DMT2 patients. Thus it can be said that maintaining glucose levels near normal can help delay or prevent complications of diabetes and reduce the impact of excessive.

Strength in this study PA levels were measured by IPAQ with MET-Minutes/Week. This study presents a study that combines Health literacy with supervised exercise-walking (BW)-focused interventions. Some limitations we should mention firstly, the small sample size did not allow us to fully evaluate the effect of PA directly. We also recognized that other diabetes-specific factors could influence PA and HbA1c changes such as treatment which we did not investigate in this study.

The conclusion of this study suggests that PA may be a modifiable factor associated with HbA1c in DMT2 patients. Our findings suggest the need for additional research to be able to explore each variable to a

longitudinal design and a large sample size and to be able to measure PA in a broad spectrum of everyday life thus enabling us to evaluate the effects of total PA and specific types of PA. In addition, the results of our research are studies conducted with a fairly short PA with a period of 3 months so for future research to continue research by evaluating the post-intervention effect of PA on HbA1c in the following months with the aim of providing evidence of the beneficial effectiveness of the associated time period. PA on HbA1c. Error bias cannot be avoided, namely medication, diet and self-efficacy factors cannot be excluded.

CONCLUSION

In summary, PA levels can be increased by an exercise-focused intervention in Takalar, Indonesia DMT2 patients. With these findings, healthcare providers should consider brisk walking physical activity interventions with appropriate media and without compromising monitoring in these interventions as one of the government's programs to improve the self-management of DMT2 patients in controlling blood sugar (HbA1c).

REFERENCES

- Lester FT. Diabetes mellitus. In: The Ecology of Health and Disease In Ethiopia. 2019.
- Wondafrash DZ, Desalegn TZ, Yimer EM, Tsige AG, Adamu BA, Zewdie KA. Potential Effect of Hydroxychloroquine in Diabetes Mellitus: A Systematic Review on Preclinical and Clinical Trial Studies. *J Diabetes Res.* 2020;2020:5214751.
- International Diabetes Federation (IDF). IDF Diabetes Atlas. 8th ed. Vol. 76. Brussels: Belgium: International Diabetes Federation; 2017.
- Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, *et al.* Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract.* 2019;157:107843.
- Care D, Suppl SS. Older adults: Standards of medical care in diabetes 2019. *Diabetes Care.* 2019;42(1):S139-47.
- Chen S, Cui Y, Ding Y, Sun C, Xing Y, Zhou R, *et al.* Prevalence and risk factors of dysphagia among nursing home residents in eastern China: a cross-sectional study. *BMC Geriatr.* 2020;20(1):1-10.
- Nfor ON, Ming-Fang W, Chun-Te L, Wang L, Liu W-H, Tantoh DM, *et al.* Body mass index modulates the association between CDKAL1 rs10946398 variant and type 2 diabetes among Taiwanese women. *Sci Reports (Nature Publ Group).* 2018;8(1):1-7.
- Jr Y, Green JB, Lum H, Peterson MJ, Huffman KM, Ph D, *et al.* Control in Older Adults with Prediabetes. 2013;60(9):1655-62.
- Karimi H, Shakil-ur-Rehman S, Gillani SA. Effects of supervised structured aerobic exercise training program on interleukin-6, nitric oxide synthase-1, and cyclooxygenase-2 in type 2 diabetes mellitus. *J Coll Physicians Surg Pakistan.* 2017;27(6):352-5.
- Lee SF, Pei D, Chi MJ, Jeng C. An investigation and comparison of the effectiveness of different exercise programmes in improving glucose metabolism and pancreatic β cell function of type 2 diabetes patients. *Int J Clin Pract.* 2015;69(10):1159-70.
- Motahari-Tabari N, Shirvani MA, Shirzad-E-AhooDashty M, Yousefi-Abdolmaleki E, Teimourzadeh M. The effect of 8 weeks aerobic exercise on insulin resistance in type 2 diabetes: a randomized clinical trial. *Glob J Health Sci.* 2015;7(1):115-21.
- Rahbar S, Naimi SS, Soltani AR, Rahimi A, Baghban AA, Rashedi V, *et al.* Improvement in biochemical parameters in patients with type 2 diabetes after twenty-four sessions of aerobic exercise: A randomized controlled trial. *Iran Red Crescent Med J.* 2017;19(7).
- Wang CMB, Inouye J, Davis J, Wang CY. Diabetes knowledge and self-management effects on physiological outcomes in type 2 diabetes. *Nurs Forum.* 2013;48(4):240-7.
- Afiatin T, Akhtar H, Reginasari A, Lutfikasari E, Penggalih BN, Nafiah NU, *et al.* Physical activity and transformational leadership as predictors of the psychological well-being of working mothers. *ANIMA Indones Psychol J.* 2019;35(1):11-34.
- Ajala O, English P, Pinkney J. Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes1-3. *Am J Clin Nutr.* 2013;97(3):505-16.
- Tuomilehto J, Lindström J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, *et al.* Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med.* 2001;344(18):1343-50.
- Credico A Di, Izzicupo P, Gaggi G, Baldassarre A Di, Ghinassi B. Effect of Physical Exercise on the Release of Microparticles with Angiogenic Potential. *Appl Sci.* 2020;10(14):4871.
- Meneguci CAG, Meneguci J, Sasaki JE, Tribess S, Júnior JSV. Physical activity, sedentary behavior and functionality in older adults: A cross-sectional path analysis. *PLoS One.* 2021;16(1):0246275.
- Buse JB, Wexler DJ, Tsapas A, Rossing P, Mingrone G, Mathieu C, *et al.* 2019 update to: Management of hyperglycemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care.* 2020;43(2):487-93.
- Rachmah Q, Setyaningtyas SW, Rifqi MA, Indriani D, Nindya TS, Megatsari H, *et al.* Self-efficacy to engage in physical activity and overcome barriers, sedentary behavior, and their relation to body mass index among elderly Indonesians with diabetes. *J Prev Med Public Heal.* 2019;52(4):242-9.
- de Melo Ghisi GL, Aultman C, Konidis R, Foster E, Tahsinul A, Sandison N, *et al.* Effectiveness of an education intervention associated with an exercise program in improving disease-related knowledge and health behaviours among diabetes patients. *Patient Educ Couns.* 2020;103(9):1790-7.
- Rothschild SK, Martin MA, Swider SM, Tumialán Lynas CM, Janssen I, Avery EF, *et al.* Mexican American trial of community health workers: a randomized controlled trial of a community health worker intervention for Mexican Americans with type 2 diabetes mellitus. *Am J Public Health.* 2014;104(8):1540-8.
- Metabolic Impacts of Confinement during the COVID-19 Pandemic Due to Modified Diet and Physical Activity Habits. *Nutrients.* 2020;12(6):1549.
- Haseler C, Crooke R, Haseler T. Promoting physical activity to patients. *BMJ.* 2019;366(2):1-7.
- Exercise Promotion in Rural Areas. 2022;26(4):2022.
- Park SH. Effects of passive static stretching on blood glucose levels in patients with type 2 diabetes mellitus. *J Phys Ther Sci.* 2015;27(5):1463-5.
- Salman A, Sellami M. Do Older Adults with Multimorbidity Meet the Recommended Levels of Physical Activity? An Analysis of Scottish Health Survey. *Int J Environ Res Public Health.* 2019;16(19):3748.
- Domin A, Ouzzahra Y, Vögele C. Features and Components Preferred by Adolescents in Smartphone Apps for the Promotion of Physical Activity: Focus Group Study. *JMIR Hum Factors.* 2022;9(2):1-10.
- Baptista S, Wadley G, Bird D, Oldenburg B, Speight J. User experiences with a type 2 diabetes coaching app: Qualitative study. *JMIR Diabetes.* 2020;5(3):e16692.
- Corella D, Asensio EM, Coltell O, Sorlí J V, Estruch R, Martínez-González MÁ, *et al.* CLOCK gene variation is associated with incidence of type-2 diabetes and cardiovascular diseases in type-2 diabetic subjects: dietary modulation in the PREDIMED randomized trial. *Cardiovasc Diabetol.* 2016;15(1):4.
- Nielsen-bohlman L, Panzer AM, David A. Health literacy: a prescription to end confusion. *Choice Reviews Online.* 2005;42(1):4059.

32. Lam MHS, Leung AYM. The effectiveness of health literacy oriented programs on physical activity behaviour in middle aged and older adults with type 2 diabetes: a systematic review. *Heal Psychol Res.* 2016;4(1):1-3.
33. Solhi M, Gharibnavaz H, Jalilian F, Motlagh F. Effectiveness of self-management promotion educational program among diabetic patients based on health belief model. *J Educ Health Promot.* 2014;3(1):14.
34. Limb ES, Ahmad S, Cook DG, Kerry SM, Ekelund U, Whincup PH, *et al.* Measuring change in trials of physical activity interventions: a comparison of self-report questionnaire and accelerometry within the PACE-UP trial. *Int J Behav Nutr Phys Act.* 2019;16(1):1-11.
35. Chudyk A, Petrella RJ. Effects of exercise on cardiovascular risk factors in type 2 diabetes: A meta-analysis. *Diabetes Care.* 2011;34(5):1228-37.
36. Paluch AE, Church TS, Blair SN. Effect of an Intensive Exercise Intervention Strategy on Modifiable Cardiovascular Risk Factors in Subjects with Type 2 Diabetes Mellitus. *Curr Cardiovasc Risk Rep.* 2011;5(6):481-3.
37. Schwingshackl L, Missbach B, Dias S, König J, Hoffmann G. Impact of different training modalities on glycaemic control and blood lipids in patients with type 2 diabetes: A systematic review and network meta-analysis. *Diabetologia.* 2014;57(9):1789-97.
38. Yang Z, Scott CA, Mao C, Tang J, Farmer AJ. Resistance exercise versus aerobic exercise for type 2 diabetes: A systematic review and meta-analysis. *Sport Med.* 2014;44(4):487-99.
39. Norris SL, Engelgau MM, Narayan KMV. Effectiveness of self-management training in type 2 diabetes: A systematic review of randomized controlled trials. *Diabetes Care.* 2001;24(3):561-87.
40. Azami G, Soh KL, Sazlina SG, Salmiah MS, Aazami S, Mozafari M, *et al.* Effect of a Nurse-Led Diabetes Self-Management Education Program on Glycosylated Hemoglobin among Adults with Type 2 Diabetes. *J Diabetes Res.* 2018;2018:4930157.
41. Lynch EB, Mack L, Avery E, Wang Y, Dawar R, Richardson D, *et al.* Randomized Trial of a Lifestyle Intervention for Urban Low-Income African Americans with Type 2 Diabetes. *J Gen Intern Med.* 2019;34(7):1174-83.
42. Spencer MS, Kieffer EC, Sinco B, Piatt G, Palmisano G, Hawkins J, *et al.* Outcomes at 18 months from a community health worker and peer leader diabetes self-management program for Latino adults. *Diabetes Care.* 2018;41(7):1414-22.
43. Mallongi A, Ernyasih. Assessment of low-cost mercury absorbent to minimize the mercury environmental and health effects in Makassar coastal areas. *J Adv Pharm Edu Res.* 2022;12(4):32-8.
44. Ernyasih, Anwar M, Sukri P, Anwar D. Calculating the Potential Risks of Environmental and Communities Health due to Lead Contaminants Exposure A Systematic Review. *J Pharm Negative Results.* 2023;14(1):68-76.
45. Masriadi, Azis R, eha Sumantri, Mallongi A. Effectiveness of non pharmacologi therapy through surveillance approach to blood pressure degradation in primary hypertension patients, Indonesia. *Indian J Public Health Res Dev.* 2018;9(2):249-55.
46. Baig AA, Benitez A, Locklin CA, Gao Y, Lee SM, Quinn MT, *et al.* Picture Good Health: A Church-Based Self-Management Intervention Among Latino Adults with Diabetes. *J Gen Intern Med.* 2015;30(10):1481-90.
47. Lynch EB, Liebman R, Ventrelle J, Keim K, Appelhans BM, Avery EF, *et al.* Design of the Lifestyle Improvement through Food and Exercise (LIFE) study: a randomized controlled trial of self-management of type 2 diabetes among African American patients from safety net health centers. *Contemp Clin Trials.* 2014;39(2):246-55.

Cite this article: Zainuddin, Abdullah AZ, Jafar N, Suriah, Nursalam, Darmawansyah, *et al.* Health Literacy Brisk Walking Exercise on Clinical Outcomes of Blood Sugar in Patients with Type 2 Diabetes Mellitus in Indonesia. *Pharmacogn J.* 2023;15(2): 433-438.