

The Effectiveness of Brisk Walking Intervention Through Comic Book Education on Self-Efficacy and HbA1c Control in Type 2 Diabetes Mellitus Patients in Rural Area at Takalar Regency

Zainuddin Zainuddin*¹, Ernawati Ernawati², Yuniar Yuniar³
Aswadi Aswadi⁴, Gusti P. Liputo⁵

^{1,5} Department of Nursing, Universitas Negeri Gorontalo, Gorontalo, Indonesia

² Department of Nursing, STIKes Tanawali Takalar, Takalar, Indonesia

³ Division of Nursing, RSUD H. Padjonga Daeng Ngalle, Takalar, Indonesia

⁴ Department of Public Health, Universitas Islam Negeri Makassar, Makassar, Indonesia

DOI: 10.24252/al-sihah.v16i1.43463

Received: 11 December 2023 / In Reviewed: 10 June 2024 / Accepted: 20 June 2024 / Available online: 28 June 2024

©The Authors 2024. This is an open access article under the CC BY-NC-SA 4.0 license

ABSTRACT

Poor self-efficacy and inability to control blood sugar (HbA1c) are special concerns in achieving structured self-management. Meanwhile, the use of educational media such as Comic book is a solution to improve the self-management of diabetes mellitus patients. Therefore, this research aimed to assess the effectiveness of comic book: BW (Brisk Walking) on self-efficacy and HbA1c control in type 2 diabetes mellitus (T2DM) patients in Takalar Regency. A quantitative method was used with a Quasi-Experimental two-group pre-post test design. The respondents were divided into two groups, namely Group 1 given comic Book: BW with WhatsApp Group monitoring, and Group 2 which received a similar intervention but without monitoring. A total of 60 respondents, 30 in each group were selected using the purposive sampling method, while data collection was carried out using the Exercise Self-Efficacy Scale (ESES) questionnaire consisting of 16 questions. Moreover, data analysis was conducted the T-test with a significance value of $p < 0.05$. The results showed that the administration of comic book: BW significantly affected self-efficacy and HbA1c Control with $p = 0.000$. BW caused a significant increase in self-efficacy and a decrease in HbA1c Control. This intervention has the potential to improve facilitate health workers and the patient self-management of type 2 diabetes mellitus through providing comic books.

ABSTRAK

Efikasi diri yang buruk dan ketidakmampuan mengontrol gula darah (HbA1c) menjadi perhatian khusus dalam mencapai manajemen diri terstruktur. Sedangkan penggunaan media edukasi seperti komik menjadi solusi untuk meningkatkan self-management pasien diabetes melitus. Oleh karena itu, penelitian ini bertujuan untuk mengkaji efektivitas media komik: BW (Brisk Walking) terhadap self-efikasi dan pengendalian HbA1c pada pasien diabetes melitus tipe 2 (DMT2) di Kabupaten Takalar. Metode yang digunakan adalah kuantitatif dengan desain Quasi-Experimental two-group pre-post test design. Responden dibagi menjadi dua kelompok, yaitu Kelompok 1 yang diberikan komik: BW dengan pemantauan Grup WhatsApp, dan Kelompok 2 yang mendapat intervensi serupa namun tanpa pemantauan. Responden berjumlah 60 orang, masing-masing kelompok berjumlah 30 orang, dipilih dengan menggunakan metode purposive sampling, sedangkan pengumpulan data dilakukan dengan menggunakan kuesioner Latihan Self-Efficacy Scale (ESES) yang terdiri dari 16 pertanyaan. Analisis data dilakukan uji T dengan nilai signifikansi $p < 0,05$. Hasil penelitian menunjukkan bahwa pemberian buku komik: BW berpengaruh signifikan terhadap efikasi diri dan pengendalian HbA1c dengan $p = 0,000$. BW menyebabkan peningkatan efikasi diri yang signifikan dan penurunan Kontrol HbA1c. Intervensi ini berpotensi meningkatkan fasilitasi petugas kesehatan dan manajemen mandiri pasien diabetes melitus tipe 2 melalui penyediaan buku komik.

GRAPHICAL ABSTRACT



Keyword

comic book
diabetes mellitus
glycated hemoglobin
self efficacy
self-management

* Correspondence

Jl. Jend. Sudirman No.6, Dulalowo Tim, Kota Tengah,
Gorontalo City 96128, Gorontalo, Indonesia
Email: zainuddin.rama@ung.ac.id

INTRODUCTION

The prevalence of diabetes mellitus (DM) is significantly higher in rural populations compared to urban (Ranasinghe et al., 2021). The condition is also more common in African Americans compared to non-Hispanic white people (Rodríguez & Campbell, 2017) with respective estimated rates of 42.8 per 100,000 versus 33.2 per 100,000 (Callaghan et al., 2020).

Self-management activities are interrelated in glycemic control, and in this context, physical activity, diet, as well as dosage are considered the three basics of DM treatment. To delay the onset of Type 2 Diabetes mellitus (T2DM), it is important to increase physical activity and improve nutritional habits in the form of a low-calorie diet which changes the main nutritional composition. Regular physical activity is recommended due to the beneficial effect on metabolic risk factors associated with the development of DM complications (Peleg-Raibstein, 2021).

In DM patients, physical activity plays a very important role in controlling blood glucose levels, specifically increasing the consumption by active muscles thereby directly causing hypoglycemia (de melo Ghisi et al., 2020). The type of activity recommended for T2DM patients is brisk walking, at a minimum speed of 3 mph (4.83 km/h) (Abdullah et al., 2023). It is recommended for people who are concerned about strenuous exercise capable of causing injury (Jabardo-Camprubí et al., 2020). Exercising, especially brisk walking, has various benefits, including preventing obesity, blood lipids, and reducing blood glucose levels, as well as mitigating complications due to DM (Hayati et al. 2021; He et al. 2018).

Physical activity recommended by ACSM (American College of Sports Medicine) and ADA (American Diabetes Association) is 150 minutes/week of brisk walking with additional resistance training for at least 2-3 days/week (Park., 2015). Brisk walking directly controls circulating blood sugar and increases tissue

sensitivity to insulin, thereby reducing the risk of cardiovascular disease and mortality (Abdullah et al., 2023; Carbone et al., 2019; Seyedizadeh et al., 2020)

DM has become a global concern with increasing prevalence, specifically, ranked as the sixth-leading cause of death worldwide. In 2021, DM accounted for a total of 6.7 million deaths worldwide with one person dying every 5 seconds, and 12 each minute. Countries with high mortality rates include China (1.39 million), followed by The United States (669), India (647), Pakistan (396), and Japan (245) (Li et al., 2019). According to the *International Diabetes Federation (2021)*, DM accounted for the third-highest cause of death in Indonesia in 2019, reaching approximately 57.42 deaths per 100,000 population. The number of DM patients in 2021 was significantly higher compared to the last decade. This number is estimated to reach 28.57 million in 2045, marking a 47% increase compared to 19.47 million in 2021.

According to Basic Health Research 2018, almost all provinces showed an increase in DM prevalence in 2013-2018, except for East Nusa Tenggara. Four provinces with the highest prevalence include Yogyakarta, DKI Jakarta, North Sulawesi, and East Kalimantan. Several provinces with a high increase up to 0.9% include Riau, DKI Jakarta, Banten, Gorontalo, and West Papua, while South Sulawesi had a prevalence of 1.8%. This prevalence is based on a doctor's diagnosis which is largely determined by the regularity and compliance of medical record keeping (Ministry of Health RI, 2019).

Based on data from the Health Office (Takalar District Health Service) in 2022, the number of DM patients in the working area of the Pattalassang, South Polombangkeng, North Polombangkeng, Ko'mara, and Mangarabombang Community Health Center was 21.7%, 5.3%, 18.8%, 4%, and 9.7% respectively. Bulukunyi, Mappakasunggu, Pattopakang, Sanrobone, Bontomarannu, Bontokassi, and Aeng Toa Community Health Center had a

prevalence of 11.4%, 3.7%, 5.2%, 2.9%, 1.5%, 0.9%, and 2.2% respectively. Additionally, Galesong, North Galesong, Bontongape, and Tana Keke Community Health Center had a prevalence of 5.5%, 5.2%, 1.3 %, and 0.7% respectively (Health Office of Takalar District, 2022).

A systematic review found a significant relationship between self-management comprising physical activity, healthy eating, glucose compliance, and solving problems related to DM self-care with blood sugar control. Self-management plays a very important role in glycemic control, and based on a systematic review, 75% of research journals showed that physical activity had a significant effect on reducing blood sugar levels compared to other components (Almutairi et al., 2020; Zainuddin et al., 2023).

Previous research (Azami et al., 2018; Lynch et al., 2019; Spencer et al., 2018) using media such as booklets, curriculum, Focus Group Discussion (FGD), and film clips to convey education achieved significant changes in behavior toward physical activity. Research conducted by Leung et al. (2018) developed comics to motivate DM patients towards engaging in physical activity. Other research also assessed 324 DM patients using a health literacy program (Gu et al., 2017). Therefore, this research aimed to assess the effect of comic book intervention with components such as knowledge, intention, skills, quality of life, and social support on improving self-efficacy and blood sugar control.

METHODS

A Quasi-Experimental method was used with a two-group pre-post test design approach to evaluate the effectiveness of comic book: BW (Brisk Walking) on self-efficacy and changes in HbA1c control among T2DM patients in Takalar Regency. The samples were selected using a purposive sampling method, while the intervention given was comic book: BW. The respondents were divided into two

groups, namely Group 1 given comic book: BW with WhatsApp Group monitoring, and Group 2 which received a similar intervention but without monitoring. The inclusion criteria include a clinical diagnosis of T2DM, age 20-60 years, HbA1c $\geq 7\%$ (preferably in the last 3 months), willingness to be a respondent by signing informed consent and filling out a questionnaire, no history of major surgery in the previous or next five months. T2DM patients receiving oral and injectable treatment as well as those who do not experience cognitive impairment were also included. Meanwhile, patients with a medical condition preventing walking for 15 minutes to 30 minutes a day were excluded.

Intervention group patients were randomly selected from one Community Health Center in Takalar Regency from a total of 16. All locations meet the criteria but taking into account 1) The effectiveness of the Prolanis program at the Community Health Center in facilitating the recruitment of respondents with at least 30 patients recruited per location, 2) Nurses administering the Prolanis program per location can participate in the intervention; 3) agree to participate for three months of the research. A total of 60 T2DM patients were recruited from May to August 2022.

Health literacy intervention was given through comic book: BW to improve self-efficacy and control HbA1c by engaging in physical activity 3-5 times a week with a total of 150 times/week (International Diabetes Federation, 2017). Furthermore, T2DM patients were advised to join the WhatsApp group and record the frequency, time, and report on BW activities for monitoring purposes.

Comic book: BW intervention includes information about the concept of DM, self-management practices including diet, exercise, foot care, glucose monitoring, medication, as well as material about self-efficacy. More specifically, it covers the importance of BW physical activity in line with recommendations by the American College of Sports Medicine

Table 1
The characteristics of respondents

| Characteristics | Group | | | |
|---|--------------|------|---------|------|
| | Intervention | | Control | |
| | n | % | n | % |
| Gender | | | | |
| Woman | 22 | 75.9 | 24 | 82.8 |
| Man | 7 | 24.1 | 5 | 17.2 |
| Education | | | | |
| No/Have never been to school | 0 | 0 | 3 | 10.3 |
| Didn't finish elementary school/MI | 0 | 0 | 3 | 10.3 |
| Finished elementary school/MI | 1 | 3.4 | 5 | 17.2 |
| Completed junior high school/junior high school | 4 | 13.8 | 6 | 20.7 |
| Finished high school/high school | 13 | 44.8 | 5 | 17.2 |
| Completed D3/D2/D1 | 2 | 6.9 | 2 | 6.9 |
| Graduated from College | 9 | 31.1 | 5 | 17.2 |
| Work | | | | |
| Doesn't Work | 7 | 24.1 | 6 | 20.7 |
| PNS/TNI/Polri/BUMN/BUMD | 5 | 17.2 | 5 | 17.2 |
| Private employees | 2 | 6.9 | 0 | 0 |
| Self-employed | 3 | 10.3 | 1 | 3.4 |
| Farmer | 0 | 0 | 2 | 6.9 |
| Fisherman | 0 | 0 | 0 | 0 |
| Retired | 8 | 27.6 | 4 | 13.8 |
| Laborer/Driver/IRT | 4 | 13.8 | 11 | 37.9 |
| Suffering from DM for a long time | | | | |
| ≤ 5 Year | 7 | 24.1 | 8 | 27.6 |
| ≥ 5 tahun | 22 | 75.9 | 21 | 72.4 |
| Treatment | | | | |
| Orally | 14 | 48.3 | 21 | 72.4 |
| Injection | 11 | 37.9 | 6 | 20.7 |
| Orally And Injection | 4 | 13.8 | 2 | 6.9 |

(ACSM) and the American Diabetes Association (ADA), namely 150 minutes per week. The Indonesian version of the material was sent through the WA group and visits were made 1-2 times a month with 5 to 10 minutes per time. At each visit, the respondents were requested to evaluate each comic book: BW material, and the obstacles faced.

Before starting the intervention, patients were gathered to receive approximately 2-3 hours of education about DM management with an introduction to comic book: BW. The pre-education process was carried out by distributing questionnaires to assess self-efficacy. The control group received usual care from the Indonesian Prolanis program which included clinical blood sugar examinations, as well as exercises and administration of comic book: BW (Brisk Walking) on self-efficacy and changes in existing HbA1c control at the discretion of each

community health center holding the program.

The Exercise Self-Efficacy Scale (ESES) is a valid, reliable, and stable tool for assessing self-efficacy in T2DM patients using a Likert Scale (1-10) with 16 question items. This instrument has a content validity index (CVI) score of 0.80-1.00. The Cronbach alpha of the Indonesian version of DQoL-BCI was 0.78, 0.80, and 0.92 indicating adequate results (Hakim et al., 2020). Glycosylated hemoglobin was measured twice (pre-and post) using the AFINION method. HbA1c level was considered good when the value was between <6.5%- 8%, and bad when >8% (Sobolesky et al., 2018).

Demographic characteristics of DM diagnosis were based on primary data from community health centers. The description started with Univariate analysis including the distribution of respondents based on gender, age, education, occupation, length of time suffering

Table 2
Differences in self-efficacy and HbA1c before and after receiving treatment

| Variables | | Mean | SD | Mean | P |
|--------------------|--------|-------|--------|--------|--------|
| Intervention Group | | | | | |
| Self Efficacy | Before | 33.52 | 4.041 | 17.62 | 0.000* |
| | After | 51.14 | 6.958 | | |
| HbA1c | Before | 9.724 | 2.1897 | -0,848 | 0.000* |
| | After | 8.876 | 1.8206 | | |
| Control Group | | | | | |
| Self Efficacy | Before | 33.52 | 8.509 | 9.69 | 0.002* |
| | After | 43.21 | 10.887 | | |
| HbA1c | Before | 9.6 | 1.8862 | 0,097 | 0.656 |
| | After | 9.697 | 1.9557 | | |

Note: *p < 0.05 significant value

from DM, and treatment. Continuous variables were presented in the form of means and standard deviation (SD) or median while categorical variables were presented in the form of frequencies and percentages. The T-test was used when the data showed a normal distribution.

The research protocol has been reviewed and approved by the Ethics Committee of the Faculty of Public Health, Hasanuddin University, Makassar with code of ethics number: 1958/UN4.14.1/TP.01.02/2022. Informed consent was obtained from all respondents, and data confidentiality was considered.

RESULTS

Among the total 60 respondents, complete data was available for 58 (96.7%) at the end of the intervention (3 months). Table 1 shows the baseline characteristics of all respondents by intervention status. The majority of respondents were female, totaling 46 individuals. The majority of respondents, amounting to 18 people, completed their high school education. A significant portion identified their profession as Laborer/Driver/Homemaker, totaling 15 individuals. Moreover, a majority of respondents have been suffering from DM for more than 5 years, comprising 43 individuals. Additionally, the predominant mode of treatment reported was oral administration, with 35 respondents indicating this preference.

Table 2 shows that the result of T-test with a significant effect in the intervention

group (p=0.000) and insignificant in the control (p=0.002). The mean value of self-efficacy before intervention was 33.52 with a standard deviation value of 4.041. After intervention, the mean value increased to 51.14 with a standard deviation of 6.958, signifying an improvement in self-efficacy. The mean HbA1c value before intervention was 9.724 with a standard deviation value of 2.1897. Meanwhile, after the intervention, the mean value was 8.876 with a standard deviation of 1.8206, indicating a change in HbA1c after being given comic book: BW.

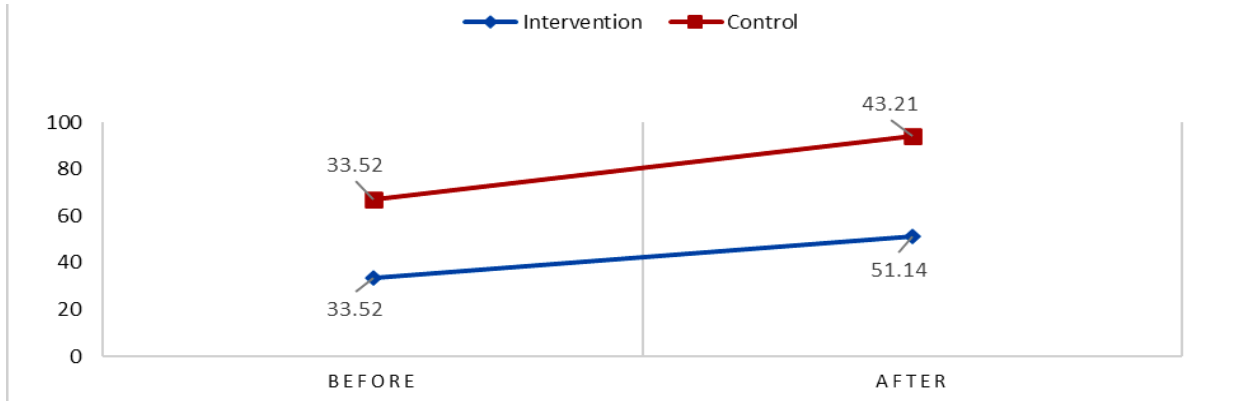
DISCUSSION

Providing comic book: BW (Brisk Walking) caused higher changes in self-efficacy for the intervention group compared to the control. Therefore, it can be concluded that the intervention had a significant effect on the self-efficacy of T2DM patients (See Figure 1).

Educational media such as comic book can be used to improve self-efficacy in managing DM at the community level and is very relevant in the context of public health. It provides information about DM and BW, directly accessible to the wider community, including those who live in remote areas or do not have direct access to health facilities through the Prolanis program.

Swoboda et al. (2017) found that providing education using telephone media significantly increased self-efficacy. Several

Figure 1
Comparison of changes in mean self-efficacy



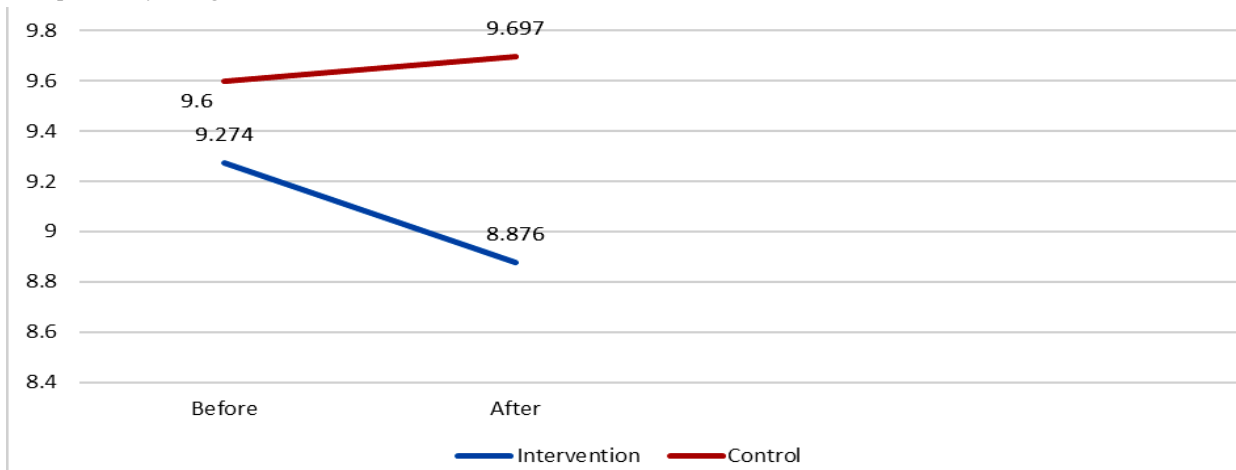
factors influence self-efficacy, including culture, gender, the nature of the task at hand, external intensity, the individual's status or role in the environment, and information about abilities (Liu et al., 2023). In the book by Erlina (2020) Bandura explained that self-efficacy is formed through cognitive, motivational, affective, and selection processes. The cognitive process in this research was aimed at providing comic book: BW intervention on how to achieve physical activity goals, knowledge, self-efficacy, and social support. The intervention comprised educational content containing motivation for engaging in physical activity according to recommendations from the American Diabetes Association (ADA), namely 150 minutes/week or a minimum of 30 minutes/day.

Bailey et al. (2015) found that patient decision assistance (PDA) could significantly

increase self-efficacy. PDA was designed to help patients understand T2DM and the various treatment options. The different treatments are organized and presented according to the main domains and preferences identified during the development process and through two focus groups with affected subjects. The PDA describes and compares the potential benefits and risks of treatments in each domain.

Based on the results, in the intervention group, the self-efficacy of T2DM patients before being given treatment was in the poor category. After treatment for three months, only five out of 29 respondents did not experience changes. In the control group, before treatment, only three respondents had good self-efficacy while 26 were in the poor category. After treatment, 15 people respondents had good self-efficacy, while 14 had poor.

Figure 2
Comparison of changes in mean HbA1c



As shown in [Figure 2](#), the HbA1c value in the intervention group experienced a significant decrease, while the mean value decreased in the control but it was not significant. Information regarding the importance of Physical Activity (PA) provided support which caused a reduction in HbA1c. Self-management practices such as physical activities are interrelated to glycemic control (HbA1c) and considered the basis of DM treatment. This was reflected in the effectiveness of the intervention among 29 patients. The results indicate that the BW program is effective in reducing HbA1c control in T2DM patients. The program entails carrying out brisk walking with a frequency of 150 minutes/week or at least 30 minutes per day and providing simple communication through WhatsApp groups as a consultation system for patients in direct contact with the health team. The use of electronic media is one of the right choices for monitoring physical activity.

The results were consistent with previous research ([Gu et al., 2017](#); [Leung et al., 2018](#)). This shows that giving comic book: BW with WhatsApp Group monitoring is more effective in reducing HbA1c compared to only education without monitoring. [Wei et al. \(2020\)](#) also showed the same results, namely a significant decrease in HbA1c values compared to the control group after being given exercise training. This research confirmed the effectiveness of comic book: BW intervention which can be used by T2DM patients. It also provides a simple communication system, namely the WhatsApp Group, and a consultation system for directly contacting patients. Compared to other media, comic book is more effective in reducing HbA1c and increasing self-efficacy.

Previous research mostly utilized leaflet media, making the use of comic book a novelty. The media was administered to 58 patients divided into two groups, namely intervention, and control, to carry out the BW intervention ([Abdullah et al., 2023](#)). Based on the results, in the intervention group, all respondents had abnormal HbA1c levels before being given treat-

ment, then after three months of treatment, only 26 respondents had abnormal HbA1c levels. Meanwhile, in the control group before and after treatment, 29 respondents had abnormal levels. The mean HbA1c level of respondents experienced minor change although not yet at the normal limit. This was because the patients' diet had not been properly programmed. In addition, the examination period was interspersed with the Eid al-Adha holiday, making it difficult for the HbA1c level to reach the normal threshold.

CONCLUSIONS

In conclusion, comic book was found to be a suitable media for increasing self-efficacy and controlling blood sugar. The media can be used as a health service provider applicable in the Prolanis program. This intervention facilitates improved blood sugar control (HbA1c) as it makes patients feel truly supported and motivated to engage in better self-care. The information is very important for health services, both health centers and hospitals, in providing educational services that suit patient needs.

The results suggest the need for additional research with a longitudinal design and large sample sizes to measure physical activity across a broad spectrum of daily life. This research assessed physical activity for a fairly short period of three months. Therefore, future investigations are recommended to evaluate the post-intervention effect of physical activity on HbA1c for a longer period to provide evidence about the beneficial effectiveness.

ACKNOWLEDGEMENT

We thank to all respondents for their willingness and participation to participate in our study

FUNDING

The authors received no specific funding for this study.

AUTHORS' CONTRIBUTIONS

Zainuddin Zainuddin formulated the concept, collected and analyzed the data, performed the field work, read and approved the final manuscript. Ernawati Ernawati designed the study, formulated the concept, analyzed the data and revised the manuscript. Yuniar Yuniar reviewed and revised manuscript. Aswadi Aswadi

designed the study. Gusti P. Liputo collected and acquired the data.

AUTHORS' INFORMATION

Dr. Zainuddin, S.Kep, Ns., M. Kep is a lecturer in Department of Nursing, Faculty of Sport and Health, Universitas Negeri Gorontalo, Indonesia. Ernawati, S.Kep, Ns, M. Kep is a lecturer Department of Nursing STIKes Tanawali Takalar, Indonesia. Yuniar, S. Kep, Ns is a Nurse of RSUD H. Padjonga Daeng Ngalle Takalar, Indonesia. Dr. Aswadi, SKM, M. Kes is a lecturer Department of Public Health, Faculty Public Health Universitas Islam Negeri Makassar, Indonesia. Gusti Pandi Liputo, S.Kep, Ns, M. Kep is a lecturer in Department of Nursing, Faculty of Sport and Health, Universitas Negeri Gorontalo, Indonesia

COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

REFERENCES

- Abdullah, A. Z., Jafar, N., Syahrul, S., & Mallongi, A. (2023). Health Literacy Brisk Walking Exercise on Clinical Outcomes of Blood Sugar in Patients with Type 2 Diabetes Mellitus in Indonesia. *Pharmacognosy Journal*, 15(2). <https://dx.doi.org/10.5530/pj.2023.15.68>
- Almutairi, N., Hosseinzadeh, H., & Gopaldasani, V. (2020). The effectiveness of patient activation intervention on type 2 diabetes mellitus glycemic control and self-management behaviors: a systematic review of RCTs. *Primary care diabetes*, 14(1), 12-20. <https://doi.org/10.1016/j.pcd.2019.08.009>
- Azami, G., Soh, K. L., Sazlina, S. G., Salmiah, M. S., Aazami, S., Mozafari, M., & Taghinejad, H. (2018). Effect of a nurse-led diabetes self-management education program on glycosylated hemoglobin among adults with type 2 diabetes. *Journal of diabetes research*, 2018(1), 4930157. <https://doi.org/10.1155/2018/4930157>
- Bailey, R. A., Pfeifer, M., Shillington, A. C., Harshaw, Q., Funnell, M. M., VanWingen, J., & Col, N. (2015). Effect of a patient decision aid (PDA) for type 2 diabetes on knowledge, decisional self-efficacy, and decisional conflict. *BMC health services research*, 16, 1-14. <https://doi.org/10.1186/s12913-016-1262-4>
- Callaghan, T., Ferdinand, A. O., Akinlotan, M. A., Towne Jr, S. D., & Bolin, J. (2020). The changing landscape of diabetes mortality in the United States across region and rurality, 1999-2016. *The Journal of Rural Health*, 36(3), 410-415. <https://doi.org/10.1111/jrh.12354>
- Carbone, S., Del Buono, M. G., Ozemek, C., & Lavie, C. J. (2019). Obesity, risk of diabetes and role of physical activity, exercise training and cardiorespiratory fitness. *Progress in cardiovascular diseases*, 62(4), 327-333. <https://doi.org/10.1016/j.pcad.2019.08.004>
- de Melo Ghisi, G. L., Aultman, C., Konidis, R., Foster, E., Tahsinul, A., Sandison, N., ... & Oh, P. (2020). Effectiveness of an education intervention associated with an exercise program in improving disease-related knowledge and health behaviours among diabetes patients. *Patient Education and Counseling*, 103(9), 1790-1797. <https://doi.org/10.1016/j.pcc.2020.04.007>
- Health Office of Takalar District. (2022). *Profil Penyakit Diabetes Melitus*.
- Erlina, L. (2020). *Efikasi Diri dalam Meningkatkan Kemampuan Mobilisasi Pasien*. Politeknik Kesehatan Kemenkes Bandung. <https://repo.poltekkesbandung.ac.id/1643/>
- Gu, L., Wu, S., Zhao, S., Zhou, H., Zhang, S., Gao, M., & Tian, D. (2017). Association of social support and medication adherence in Chinese patients with type 2 diabetes mellitus. *International journal of environmental research and public health*, 14(12), 1522. <https://doi.org/10.3390/ijerph14121522>
- Hakim, A. R., Wang, S. T., Widiatoro, F. X., Hannan, M., Wang, C. J., & Fetzer, S. J. (2020). The Indonesian version of the exercise self-efficacy scale: cross-cultural adaptation and psychometric testing. *Asian Nursing Research*, 14(5), 300-305. <https://doi.org/10.1016/j.anr.2020.08.008>
- Hayati, K. (2021). Pengaruh Brisk Walking Exercise Terhadap Penurunan Kadar Gula Darah Pada Pasien DM Tipe II Di Rumah Sakit Grandmed Lubuk Pakam. *Jurnal Penelitian Keperawatan Medik*, 3(2), 23-29. <https://doi.org/10.36656/jpkm.v3i2.660>
- He, L. I., Wei, W. R., & Can, Z. (2018). Effects of 12-week brisk walking training on exercise blood pressure in elderly patients with essential hypertension: a pilot study. *Clinical and Experimental Hypertension*, 40(7), 673-679. <https://doi.org/10.1080/10641963.2018.1425416>
- International Diabetes Federation. (2021). *IDF Diabetes Atlas*. <https://diabetesatlas.%0Aorg/>
- Jabardo-Camprubí, G., Donat-Roca, R., Sitjà-Rabert, M., Milà-Villarroel, R., & Bort-Roig, J. (2020). Drop-out ratio between moderate to high-intensity physical exercise treatment by patients with, or at risk of, type 2 diabetes mellitus: a systematic review and meta-analysis. *Physiology & behavior*, 215, 112786. <https://doi.org/10.1016/j.physbeh.2019.112786>
- Leung, A. Y., Leung, I. S., Liu, J. Y., Ting, S., & Lo, S. (2018). Improving health literacy and medication compliance through comic books: a quasi-experimental study of Chinese community-dwelling older adults. *Global Health Promotion*, 25(4), 67-78. <https://doi.org/10.1177/1757975918798364>
- Li, J., Chattopadhyay, K., Xu, M., Chen, Y., Hu, F., Wang, X., & Li, L. (2019). Prevalence and predictors of polypharmacy prescription among type 2 diabetes patients at a tertiary care department in Ningbo, China: a retrospective database study. *PLoS One*, 14(7), e0220047. <https://doi.org/10.1371/journal.pone.0220047>
- Liu, J., Li, Q., Sun, X., Zhu, Z., & Xu, Y. (2023). Factors influencing programming self-efficacy: an empirical study in the context of Mainland China. *Asia Pacific Journal of Education*, 43(3), 835-849. <https://doi.org/10.1080/02188791.2021.1985430>
- Lynch, E. B., Mack, L., Avery, E., Wang, Y., Dawar, R., Richardson, D., ... & Fogelfeld, L. (2019). Randomized trial of a lifestyle intervention for urban low-income African Americans with type 2 diabetes. *Journal of general internal medicine*, 34, 1174-1183. <https://doi.org/10.1007/s11606-019-04894-y>
- Ministry of Health RI. (2019). Laporan Nasional Riskesdas 2018. In *Badan Penelitian dan Pengembangan, Kementerian Kesehatan RI* (Vol. 1, Issue 1). <https://www.kemkes.go.id/article/view/19093000001/penyakit-jantung-penyebab-kematian-terbanyak-ke-2-di-indonesia.html>
- Park, S. H. (2015). Effects of passive static stretching on blood glucose levels in patients with type 2 diabetes mellitus. *Journal of physical therapy science*, 27(5), 1463-1465. <https://doi.org/10.1589/jpts.27.1463>
- Peleg-Raibstein, D. (2021). Understanding the link between maternal overnutrition, cardio-metabolic dysfunction and cognitive aging. *Frontiers in Neuroscience*, 15, 645569. <https://doi.org/10.3389/fnins.2021.645569>
- Ranasinghe, P., Jayawardena, R., Gamage, N., Sivanandam, N., & Misra, A. (2021). Prevalence and trends of the diabetes epidemic in urban and rural India: A pooled systematic review and meta-analysis of 1.7 million adults. *Annals of*

- epidemiology*, 58, 128-148.
<https://doi.org/10.1016/j.annepidem.2021.02.01>.
- Rodríguez, J. E., & Campbell, K. M. (2017). Racial and ethnic disparities in prevalence and care of patients with type 2 diabetes. *Clinical Diabetes*, 35(1), 66-70.
<https://doi.org/10.2337/cd15-0048>
- Seyedizadeh, S. H., Cheragh-Birjandi, S., & Hamed Niya, M. R. (2020). The effects of combined exercise training (resistance-aerobic) on serum kinesin and physical function in type 2 diabetes patients with diabetic peripheral neuropathy (randomized controlled trials). *Journal of diabetes research*, 2020(1), 6978128.
<https://doi.org/10.1155/2020/6978128>
- Sobolesky, P. M., Smith, B. E., Saenger, A. K., Schulz, K., Apple, F. S., Scott, M. G., & Fitzgerald, R. L. (2018). Multi-center assessment of a hemoglobin A1c point-of-care device for diagnosis of diabetes mellitus. *Clinical Biochemistry*, 61, 18-22.
<https://doi.org/10.1016/j.clinbiochem.2018.09.007>
- Spencer, M. S., Kieffer, E. C., Sinco, B., Piatt, G., Palmisano, G., Hawkins, J., & Heisler, M. (2018). Outcomes at 18 months from a community health worker and peer leader diabetes self-management program for Latino adults. *Diabetes care*, 41(7), 1414-1422.
<https://doi.org/10.2337/dc17-0978>
- Swoboda, C. M., Miller, C. K., & Wills, C. E. (2017). Impact of a goal setting and decision support telephone coaching intervention on diet, psychosocial, and decision outcomes among people with type 2 diabetes. *Patient education and counseling*, 100(7), 1367-1373.
<https://doi.org/10.1016/j.pec.2017.02.007>
- Wei, Y., Chen, Y., Zhao, Y., Rothman, R., Ming, J., Wang, L., & Xu, W. (2020). Health literacy and exercise interventions on clinical outcomes in Chinese patients with diabetes: a propensity score-matched comparison. *BMJ Open Diabetes Research and Care*, 8(1), e001179.
<https://doi.org/10.1136/bmjdr-2020-001179>
- Zainuddin, Z., Abdullah, A. Z., Jafar, N., Suriah S., Nursalam N., Darmawansyah D., Widiantoro X., & Irfandi, R. (2023). The application of social cognitive theory (SCT) to the mHealth diabetes physical activity (PA) app to control blood sugar levels of type 2 diabetes mellitus (T2DM) patients in Takalar regency. *Journal of Public Health Research*, 12(2), 22799036231172759.
<https://doi.org/10.1177/22799036231172759>