Research Paper

Effectiveness of Tailored Care Intervention Program on Biochemical Outcomes of Patients With Diabetes in Indonesia: A Randomized Controlled Trial

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ABSTRACT

Background: Although patients with diabetes have common problems, their educational needs may differ, and they have the right to participate in planning and implementing individual or group healthcare programs. Because there are no proper care interventions for diabetic patients in Indonesia, this study evaluated the efficacy of a tailored care intervention program on some blood biochemical outcomes among Indonesian patients with diabetes.

Methods: We conducted a randomized controlled trial (RCT) with a pre-test-post-test design. We recruited 163 diabetic patients referred to Moyo Hilir and Moyo Hulu primary healthcare facilities in Sumbawa City, Indonesia, from January to April 2021. The subjects were randomly assigned to either intervention (n=80) or control (n=83) groups. The intervention group received a tailored care intervention program with 7 elements implemented through four stages: 1) brief deductive teaching, 2) self-management assessment, 3) brainstorming and support group, and 4) Follow-up. The control group received routine education. The study data were collected at baseline and three months after the intervention. The outcome measures were blood glucose levels, cholesterol, triglyceride, and triglyceride glucose index. IBM SPSS software, version 20 was used for statistical analysis. The obtained data were analyzed by descriptive (frequency distributions, percentages, Mean±SD) and inferential statistics (Chi-square, independent t-test, and paired t-test). The significance level was set at $P<0.05$.

Results: According to the independent t-test, there were no significant differences in blood glucose levels of the groups before and after the intervention. There were also no significant differences in the groups' cholesterol, triglyceride, and triglyceride glucose index before the intervention, but significant differences were seen after the intervention (P=0.000). However, the significance moved in a negative direction. According to paired t-test, blood glucose level, triglyceride, and triglyceride glucose index increased in the control group but decreased in the intervention group, although it was not significant. On the other hand, cholesterol levels increased in both intervention and control groups, which was not significant.

Conclusion: Although no significant findings were obtained, the glucose level, triglyceride, and glucose triglyceride index values of the intervention group were better than the control group, but not in terms of cholesterol level. Tailored care intervention programs can improve biochemical indicators, especially for blood glucose levels, triglycerides, and triglyceride glucose index; however, it seems that a follow-up study beyond three months is needed to be performed in the future.

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Highlights

• Tailored care intervention programs are more focused on the needs of each patient.

• The tailored care intervention emphasizes that every patient can participate in individual and group healthcare planning and implementation.

• According to the study results, although there was no significant difference between the two groups, the glucose, triglyceride, and triglyceride glucose index of the intervention group was better than the control group, but not in terms of cholesterol level.

Plain Language Summary

Tailored care intervention programs focus on each patient's needs (cognitive-social factors, intention, and behavior). Tailored care aims to improve health outcomes and patients' care experience by considering their unique needs and preferences when developing a care plan. In tailored care intervention, there are opportunities to implement individual care that can facilitate health services for diabetic patients in Indonesia and reduce complications by controlling blood glucose levels, cholesterol, and insulin resistance. This study evaluated the efficacy of a tailored care intervention program on some blood biochemical outcomes among Indonesian patients with diabetes. According to the results, the intervention group's glucose, triglyceride, and glucose triglyceride index values were better than the control group, but this difference was not significant. Cholesterol level increased in both groups and was therefore not significant.

1. Introduction

The inability of people with diabetes to control their blood glucose level, cholesterol, and triglyceride impacts insulin resistance conditions which nurture the rapid occurrence of complications due to diabetes in the future (Chawla et al., 2016; Papatheodorou et al., 2018). A common indicator used in hospitals to determine whether a diabetic patient has insulin resistance is calculating triglyceride glucose index (Alizargar et al., 2020; Lim et al., 2019; Liu et al., 2021; Nam et al., 2020). Many researchers and experts mention in their study that controlling blood glucose levels <200 mg/dL, cholesterol <200 mg/dL, triglycerides <150 mg/dL, and triglycerides glucose index <4.51 will reduce the risk of complications due to diabetes (Alizargar et al., 2020; Liu et al., 2021; Oguntibeju, 2013; Park et al., 2019).

Health education is important in reducing the risk of complications in people with diabetes (Sassen, 2018). However, the reality is that health education provided by health professionals is still based on a common approach rather than a personal care approach. Several studies indicate that tailored care intervention programs can change the behavior of people with diabetes through a personalized approach (Cimo & Dewa, 2019; Hertroijs et al., 2018; Pranata et al., 2022). Also, various indicators such as blood glucose, cholesterol, triglycerides, and triglyceride glucose index are under control (Alizargar et al., 2020; Liu et al., 2021; Oguntibeju, 2013; Park et al., 2019). In addition, research has shown that tailored care intervention programs can be implemented in Indonesia (Pranata et al., 2022). Tailored care intervention programs focus more on each patient's requirements (social-cognitive factors, intention, and behavior) (Pranata et al., 2021& 2022). The approach in tailored care education emphasizes that every patient has the right to participate in individual and group healthcare planning and implementation (Sassen, 2018; World Self-medication Industry, 2010). Additionally, patient-centered education through tailored care intervention program increases satisfaction and is crucial for efficient patient education (Sassen, 2018).

Tailored care aims to improve patients' health outcomes and care experience by considering their unique requirements and preferences when developing a treatment plan (Dekkers & Hertroijs, 2018; Hertroijs et al., 2018). Such an approach might be a personalized strategy based on patient phenotype. According to this method, biopsychosocial characteristics are used to distinguish subgroups of patients with comparable care requirements, capacities, and preferences so that customized treatment plans can be constructed (Dekkers & Hertroijs, 2018; Hertroijs et al., 2018; Lutes et al., 2020; Osborn et al., 2010). The increasing rates of morbidity and mortality that now is observed in the diabetic popu-

lation may be reduced by modifying educational programs that are customized for that specific population (Cimo et al., 2020), patient preferences, cultural sensitivity, patient-centeredness, and reference to individualized care (Cimo et al., 2020; Dekkers & Hertroijs, 2018; Hertroijs et al., 2018; Lutes et al., 2020; Osborn et al., 2010; Solano et al., 2020). Allowing clients' requirements to direct diabetes education, adapting instruction to match individual needs, and empowering clients to self-manage are all components of tailored care (Cimo & Dewa, 2019). There is much opportunity for personalized care in tailored care intervention programs to be implemented in Indonesia to enhance health services for diabetic patients (Pranata Satriya et al., 2021). A tailored care plan for managing diabetes may help patients be confident in practicing health behaviors and decrease the risk of complications by controlling their blood glucose level, cholesterol, and insulin resistance. Thus, this study was planned to assess how effective is a tailored care intervention program for diabetic patients. The evaluation focused on biochemical outcomes (blood glucose level, cholesterol, and insulin resistance through indicators of triglyceride and triglyceride glucose index).

2. Materials and Methods

Design, setting, and sample

A randomized controlled trial (RCT) with a pre-test-post-test design was used. The study was conducted between January and April 2021. The subjects were patients with diabetes who attended and registered at Moyo Hilir and Moyo Hulu primary health care centers in Sumbawa City, West Nusa Tenggara, Indonesia. The diabetic population in this study was diagnosed using laboratory tests (HbA1c and or blood glucose) as well as a physician's diagnosis.

To calculate the sample size, the level of significance or (α)=0.05, population effect size (ES)=0.5, and power (1-β)=0.80 (Kim, 2016). Calculations showed a sample size of 126 (64 in each group) was adequate. To account for the dropout, the researcher increased the number of participants by 30%. Consequently, 168 volunteers were required for this investigation (84 per group). Lists of the names of potential respondents with required inclusion criteria who had performed health checks routinely in primary healthcare centers and had complete laboratory data, especially HbA1c, from September to December 2021 were collected and then randomized into two groups using the Excel program to avoid selection bias for group allocation. Figure 1 shows the recruitment process for this randomized control trial. The inclusion criteria were as follows: being older than 20 at the time of recruitment, identifying as the Indonesian ethnic group, being willing to participate in the trial, having a mobile device, and residence with family. Patients who live with their families will make it simpler for the researcher to follow up with them or to phone them to remind them to follow the study's protocol. People who could not make their decisions and had a history of or a diagnosis of ischemic heart disease, transient ischemic attack (TIA), peripheral vascular disease, or persistent mental health issues were excluded.

Usual care

Basic healthcare services for diabetic patients typically focus on 5 important areas: Food, medications, physical activity, health education, and routine blood sugar monitoring. Also, blood pressure measurement and monthly health counseling (Suciana & Arifianto, 2019) were done for all patients. A leaflet or booklet is typically used in basic healthcare education, even though many media deliver health advice (Srikartika et al., 2019). Brochures and pamphlets usually advise how to modify one's diet, utilize treatments like insulin or oral ones, and recognize the clinical indicators of blood sugar changes (Nanda et al., 2018; Srikartika et al., 2019). In our study, respondents in the control group received usual health education, where education was provided only in the form of leaflets with a brief explanation by health professionals.

Tailored care intervention program

The tailored care program in this study is an interdisciplinary approach with collaboration among healthcare professionals, patients, and families. Patients become the center of care services by considering their personalized preferences and ethnic values. This program can help the patients achieve personalized self-management and glycemic control goals. The strategies of tailored care for diabetes were divided into 7 steps: 1) brief deductive teaching, 2) assessment for self-management level, 3) brainstorming among patients to share their difficulty on glycaemic target and specific target behavior, 4) making a list of patients' needs then ranking the priorities, 5) setting a goal and writing action, 6) follow-up, and 7) reporting goals attempt.

Brief deductive teaching activities were carried out by health professionals (nurse, physician, and dietitian) as presenters. Health professionals explained about 1) treatment options for high or low blood sugar levels, 2) proper nutritional treatment, 3) how to combine daily physical activity and exercise, 4) when the condition requires patients to

consume drug or insulin medication, 5) teach patients for blood glucose self-monitoring test, 6) acute comorbidity prevention, detection, and treatment, 7) chronic comorbidity prevention, detection, and treatment, 8) goal-setting and achievement-based health promotion, and 9) integration of psychological adjustment for daily living and problem-solving advice. After completing deductive teaching, the nurse assessed the level of patient self-management and the percentages of patients at risk for complications. The patients were then divided into groups to brainstorm the glycemic target and specific target behavior difficulties. The patients were divided into 10 groups of 8-9 respondents. A facilitator accompanies this support group to ensure patient information exchange is safe and there is no malpractice risk when patients apply it themselves at home. The experience they gained from the discussion in the support group became the basis for choosing the most appropriate intervention to keep their blood glucose stable at home. The goal that patients have in mind to achieve and the intervention program they have chosen can be written in their monitoring book. Health professionals can read monitoring books when patients with diabetes carry out health control routinely every month at primary health care. Each report in the monitoring book was valuable data for hospitals or health facilities to determine the most appropriate interventions for each patient. The strategies and how to implement tailored care for diabetes (Pranata et al., 2022) are presented in Table 1. It is worth mentioning that there was no contact between participants in the intervention and control groups. The Sumbawa City area is very large and sparsely populated; therefore, the distance between the respondents was very far, minimizing the possibility of their interaction. The patients were reminded to observe and follow up on the provided training through phone calls. All the subjects were blinded to their group allocation.

Laboratory tests

The blood glucose level, cholesterol, triglycerides, and triglyceride glucose index were measured with laboratory tests at two time points (before and three months after the intervention). Blood samples were collected by a research assistant in coordination with the laboratory and transported to the laboratory center of Sumbawa City. This laboratory center was chosen because not all tests are available in the primary health care center laboratory. The test kit and method were the same in all cases.

Demographic and disease characteristics

The demographic characteristics included the patients' sex, age, religion, educational level, marital status, complications, smoking, and time since the diagnosis of diabetes.

Data analysis

IBM SPSS software, version 20 (IBM Corporation, Armonk, NY, USA) was used for statistical analysis. Descriptive (frequency distributions, percentages, Mean±SD and inferential statistics (Chi-square, ANOVA, independent sample t-test, and paired t-test) were utilized for data analysis.

3. Results

The comparison of the demographic characteristics of the participants of the two groups is presented in Table 2.

Most respondents in the intervention (78.75%) and control (79.14%) groups were female. The education level of most participants was a primary school in the intervention (66.25%) and control (63.86%) groups. Most patients were married in both groups (98.75% and 98.79% in the intervention and control groups). Most patients in the intervention (98.75%) and control (97.59%) groups had no complications. Most patients were non-smokers in both groups (90% and 92.77% in the intervention and control groups, respectively) (Table 2).

As shown in Tables 2 and 3, there is no significant difference between the groups' baseline characteristics.

Description and comparison of the outcome indicators for the two groups in the pre-test and post-test stages are presented in Table 4.

There were no significant differences in the blood glucose level of the groups before and after the intervention. Also, there were no significant differences in cholesterol, triglyceride, and triglyceride glucose index between the groups before the intervention, but significant differences were observed after the intervention. However, according to the independent t-test analysis in Table 4, the significance moved in the negative direction. Accordingly, it was required to utilize additional tests using the paired t-test to compare the effectiveness of routine health education and tailored care program before and after the intervention.

The paired t-test analysis (Table 5) showed that the control group's blood glucose level, triglyceride, and triglyceride glucose index increased. Still, it decreased in the intervention group, although it was not significant. On the other hand, cholesterol level increased in both intervention and control groups, which was not significant.

Table 1. Tailored care program strategies

Topics	Tailored Care Program for Diabetes
What is taught?	Providing integrated care through inter-professional collaborative practice based on elements of tailored care for patients with diabetes to improve patients' blood glucose level, cholesterol, and insulin resistance through triglyceride and triglyceride glucose index indicators.
What is the goal?	Achieving biochemical outcomes (blood glucose level, cholesterol, and insulin resistance through indicators of triglyceride and triglyceride glucose index).
Who is the educational team?	Healthcare professionals (nurses, physicians, dieticians) and patients with diabetes.
Procedures?	Preparation before implementing a tailored care program for diabetes Apperception related to all processes and procedures to be carried out in the study with two research assistants. Research assistants attended an apperception about using tailored care and practice skills for managing groups. After the apperception, facilitators were supported to deliver the intervention. Application of the tailored care program for diabetes Brief deductive teaching[1] Firstly, it is necessary to hold a seminar attended by patients with diabetes. This seminar was participated in with speakers from experts in their fields, such as nurses, doctors, and nutritionists. The seminar includes methods that patients can self-manage to maintain their blood glucose stable while at home. Assessment for self-management level and cardiovascular disease (CVD) risk among patients. After deductive teaching, the nurse conducts an assessment to determine the level of patient self-management[2] and how many patients are at risk of complications. The risk report was personalized to describe individual complication risks. Then, the patients with a high risk of complications were treated by the sub-specialist physician[3, 4]. Patients were divided into groups to brainstorm the difficulties with glycemic targets and specific target behavior[5]. Brainstorming among patients to share their difficulty with glycemic targets and specific target behavior[6, 7] Programs in support groups between diabetic patients were a good method for patients to share their experiences regarding their lifestyle for blood sugar control[3, 5]. A facilitator accompanies this support group to ensure patient information exchange is safe and there is no malpractice risk when patients apply it themselves at home. Make a list of patients' needs, then rank the priorities The experience they gained from the discussion in the support group became the basis for choosing the most appropriate invention to keep their blood glucose stable at home [3, 6, 7]. Setting a goal and writing action[4] The goal that patients have in mind to achieve and the intervention program they have chosen can be written in their monitoring book. Monitoring books can be read by health workers when patients with diabetes carry out health control routinely every month at primary health care. Follow-up[4] Each report in the monitoring book was valuable data for hospitals or health facilities to determine the most appropriate interventions for patients in the future. Report of goals attempt After three months, the participants report the results of their efforts and determine to what extent their goals have been achieved. Moreover, the outcome evaluation (physical, self-management, psychosocial, self-care activity, risk assessment for diabetes complication) is also done.
Elements-based/ concept based	Patient preferences Patient values Self-management Inter-professional collaboration Tailored support Glycemic control Patient-centered

1. Inter-professional collaboration
2. Self-management
3. Tailored support
4. Patient-centered
5. Glycemic control
6. Patient preferences
7. Patient values.

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4. Discussion

Blood glucose levels increased in the control group but decreased in the intervention group (although not significant). Participants in the intervention group, who received a tailored care intervention program, had lower blood sugar levels than those in the control group, who received routine care. According to the results, the usual approach to diabetes care failed to meet the demands of patients. When training programs are inappropriate, be-

Table 2. Comparing the participants' characteristics in the intervention and control groups

Variables		No. (%) (n=163)			Sig.
		Intervention n=80	Control n=83	Total	
Sex	Male	17(21.25)	17(20.48)	34(20.86)	0.905*
	Female	63(78.75)	66(79.52)	129(79.14)	
Religion	Islam	80(100)	83(100)	163(100)	
Education level	Illiterate	1(1.2553)	2(2.4)	3(1.84)	0.726*
	Primary school	(66.25)	53(63.86)	106(65.03)	
	Junior high school	7(8.75)	5(6.03)	12(7.36)	
	Senior high school	11(13.75)	13(15.66)	24(14.73)	
	college	8(10)	10(12.05)	18(11.04)	
Marital status	Single	0(0)	1(1.21)	1(0.61)	0.179*
	Married	79(98.75)	82(98.79)	161(98.78)	
Complications	None	79(98.75)	81(97.59)	160(98.16)	0.585*
	Hypertension	1(1.25)	2 (2.41)	3(1.84)	
Smoking	Smoking	8(10)	6(7.23)	14(8.59%)	0.531*
	No smoking	72(90)	77(92.77)	149(91.41%)	

*The Chi-square test.

Client- Centered Nursing Care

havior change will be ineffective and inaccurate (Choi et al., 2017). In contrast, an intervention based on the patient's preferred language and the combination of nutritional information sensitive to cultural differences and the same cultural group may, through tailored care, affect the patient's willingness to engage in behavioral changes and compliance and thus lead to reduced levels of blood sugar (Navodia et al., 2019).

Cholesterol levels increased in the intervention and control groups-instead of reduction. The body needs cholesterol to function, but high cholesterol levels can cause atherosclerosis and cardiovascular disease (Karakas & Koenig, 2010; Vaccaro & Huffman, 2012; Virani et al., 2020) in conjunction with the National Institutes of Health, annually reports on the most up-to-date statistics related to heart disease, stroke, and cardiovascular risk factors, including core health behaviors (smoking, physical activity, diet, and weight. The recommended treatment of hypercholesterolemia involves weight loss, dietary and physical activity changes, and a possible medical regime (Vaccaro & Huffman, 2012) anthropometric, and laboratory data from two cycles of the National Health and Nutrition Survey (2007-2008 and 2009-2010. The increase in cholesterol levels among respondents in both study groups may be closely related to their decreased exercise and weight gain during the pandemic. The Indonesian government's policy regarding the COVID-19-related "new normal" has significantly affected how people move around during the pandemic (Bapennas, 2020; Pragholapati, 2020; Rosidi & Nurcahyo, 2005). Their lack of physical activity was worsened by how frequently they were asked to stay home. Lack of exercise and fat storage are linked to higher cholesterol

Table 3. Participants characteristics

Variables	Intervention			Control			Sig.
	Min-max	Mean±SD	95%CI	Min-max	Mean±SD	95% CI	
Age (y)	37-76	55.53±9.237	53.47-57.58	33-79	57.61±9.243	55.60-63	0.151**
Time since the diagnosis of diabetes (y)	1-11	3.345±2.477	2.794-3.896	1-15	3.837±3.305	3.116-5.59	0.285**

**ANOVA.

Client- Centered Nursing Care

Table 4. Description of the outcome indicators for the two groups

Variables		Intervention		Control		Sig.
		Pre-test	Post-test	Pre-test	Post-test	
Blood glucose level	Mean±SD	255.19±109.867	245.60±116.650	227.81±121.905	245.94±105.207	
	Median	253.50	218	205	237	Pre-test=0.807**
	Min-max	76-512	84-595	72-594	91-595	Post-test=0.356**
	95% CI	230.74-279.64	219.64-271.56	201.19-254.43	222.97-268.91	
Cholesterol	Mean±SD	186.74±44.587	209.56±38.317	188.41±42.884	203.42±45.901	
	Median	181	210	190	201	Pre-test=0.939**
	Min-max	114-389	121-300	106-340	88-398	Post-test=0.000**
	95% CI	176.82-196.66	201.04-218	179.05-197.77	193.40-213.44	
Triglyceride	Mean±SD	227.86±85.060	221.80±122.779	230.33±80.457	262.88±93.954	
	Median	204.50	185.50	207.00	264	Pre-test=0.638**
	Min-max	90-501	47-676	91-502	89-655	Post-test=0.000**
	95% CI	208.93-246.79	194.48-249.12	212.76-247.89	242.36-283.39	
Triglyceride glucose index	Mean±SD	5.23±0.705	5.14±0.464	5.22±0.703	5.49±0.562	
	Median	5.11	5.10	5.13	5.57	Pre-test=0.916**
	Min-max	4-7	4-6	4-7	4-7	Post-test=0.000**
	95% CI	5.08-5.39	5.04-5.25	5.07-5.38	5.37-5.62	

**The independent t-test.

levels (Vaccaro & Huffman, 2012) anthropometric, and laboratory data from two cycles of the national health and nutrition survey (2007-2008 and 2009-2010.

Triglyceride levels increased in the control group but decreased in the intervention group. The liver produces triglyceride, but most come from food (Alves-Bezerra & Cohen, 2018). If necessary, the food's fat will be turned into energy. Not all body fat is utilized right away. Unused fat is converted into triglycerides and retained in the body. Triglyceride or fat is released when needed and used as energy. However, too much triglyceride in the blood can cause the artery wall to thicken, which raises the risk of heart disease and stroke (Alves-Bezerra & Cohen, 2018; Miller et al., 2011; Rafieian-Kopaei et al., 2014) focusing on new findings in atherosclerosis markers and its risk factors. Furthermore, the role of antioxidants and medicinal herbs in atherosclerosis and endothelial damage has been discussed and a list of important medicinal plants effective in the treatment and prevention of hyperlipidemia and atherosclerosis is presented. METHODS: The recently published papers about atherosclerosis pathogenesis and herbal medicines effective in the treatment and prevention of hyperlipidemia and atherosclerosis were searched. RESULTS: Inflammation has a crucial role in pathogenesis of atherosclerosis. The disease is accompanied by excessive fibrosis of the intima, fatty plaques formation, proliferation of smooth muscle cells, and migration of a group of cells such as monocytes, T cells, and platelets which are formed in response to inflammation. The oxidation of low density lipoprotein (LDL. Moreover, high levels of triglycerides in the blood often appear without causing symptoms. The high triglyceride levels of the study participants were probably related to weight gain and high carbohy

drate intake. This finding shows how challenging it is to change the dietary and lifestyle patterns associated with obesity (Goodfellow et al., 2016) although evidence on how to maximise the effectiveness of tailoring is limited. In England, overweight and obesity are common, and national guidelines have been produced by the

Table 5. Comparing blood glucose level, cholesterol, triglyceride, and triglyceride glucose index for the two groups (paired t-test)

Variables	Paired t-test	Mean±SD	t	P	Status
Blood glucose level	Pair 1 pre-post	9.588±140.597	0.610	0.544	ns
	Pair 2 pre-post	-18.133±-110.646	-1.493	0.139	ns
Cholesterol	Pair 1 pre-post	-22.825±52.728	-3.872	0.000	ns
	Pair 2 pre-post	-15.012±-56.318	-2.428	0.017	ns
Triglyceride	Pair 1 pre-post	6.063±83.017	0.653	0.516	ns
	Pair 2 pre-post	-32.554±-62.298	-4.761	0.000	ns
Triglyceride glucose index	Pair 1 pre-post	0.088±0.776	1.009	0.316	ns
	Pair 2 pre-post	-0.271±-0.470	-5.247	0.000	ns

Abbreviations: Pair 1: Intervention group before and after; Pair 2: Control group before and after; ns: Non-significant.

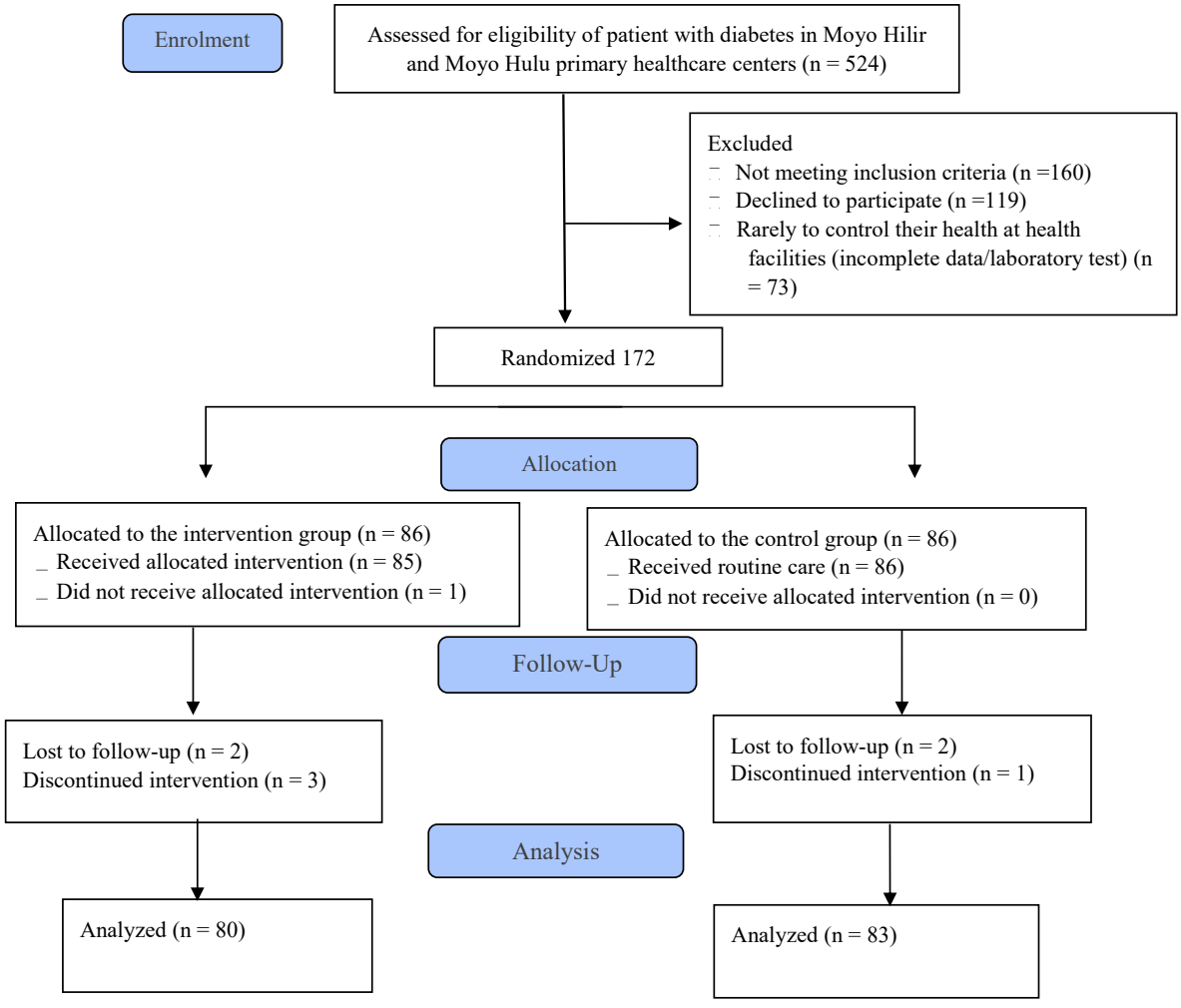

Figure 1. Recruitment process for the randomized controlled trial

National Institute for Health and Care Excellence. However, the guidelines are not routinely followed in primary care. Methods: A tailored implementation intervention was developed following an analysis of the determinants of practice influencing the implementation of the guidelines on obesity and the selection of strategies to address the determinants. General practices in the East Midlands of England were invited to take part in a cluster randomised controlled trial of the intervention. The primary outcome measure was the proportion of overweight or obese patients offered a weight loss intervention. Secondary outcomes were the proportions of patients with (1. It may be necessary for future studies to overcome problems such as patient motivation, barriers to access to specialists, and the short interval between intervention and subsequent measurement of variables.

The triglyceride glucose index increased in the control group but decreased in the intervention group. Therefore, the intervention group was better than the control group regarding the triglyceride glucose index. Triglyceride glucose index examination is an alternative to determine whether a person has insulin resistance (Khan et al., 2018; Liu et al., 2021). The triglyceride glucose index is a cheaper and simpler test than the homeostasis model assessment-insulin resistance (HOMA-IR) index (Hong et al., 2020). Not all laboratories and hospitals in Indonesia can perform the HOMA-IR test. Therefore, the triglyceride glucose index can be one of the best choices in determining a person with insulin resistance. Many studies show that the triglyceride glucose index is highly specific for diagnosing insulin resistance (Khan et al., 2018; Liu et al., 2021). Insulin resistance can be confirmed if the triglyceride glucose index is more than 4.49. In this study, the respondents in the intervention and control groups had a triglyceride glucose index above 5 on average before and after the intervention program. In other words, the average respondent in the intervention and the control group experienced insulin resistance before and after the intervention. Insulin resistance refers to a condition in which body cells cannot properly use blood sugar due to impaired insulin response. A person can be insulin resistant for a long time without realizing it. Insulin resistance is a factor that can increase the risk of diabetes complications related to blood vessels, such as heart disease and stroke (Alizargar et al., 2020; Nam et al., 2020; Park et al., 2019). Insulin resistance can also cause nerve damage to the eyes, feet, and hands and kidney failure (Chawla et al., 2016). This condition ultimately impacts the emergence of complications such as diabetic neuropathy and chronic renal disease.

Implementing a tailored care intervention program in diabetic patients did not cause a significant reduction in the triglyceride glucose index or the risk of insulin resistance.

In general, the lack of effectiveness of the intervention in this study can be related to non-compliance with treatment in patients with diabetes. Especially considering that most of the participants were female and married and had a primary school literacy level, it is possible that low literacy, doing housework and taking care of children, and the need to prepare food that the family likes, have reduced compliance further. Pound et al. (1996) found that the quality of diabetes control is worse in women than in men because women often have both to cope with their diabetes and care for their families. Al-Rasheedi (2014) found that the level of education did not affect blood sugar control, but patients with higher education had better knowledge of complications and were more adherent to diet. It is also worth noting that expertise does not necessarily lead to performance. In Alqahtani et al. (2020) study, more than half (68%) of the patients had never checked their blood glucose levels in the last year, while their knowledge score was good. Also, in Al-Maskari et al. (2013) study, 57% of diabetic patients had HbA1c levels indicating poor blood glucose control, and only 17% reported adequate blood glucose control.

One of the limitations of this study is the relatively short time interval between intervention and re-control of diabetes laboratory indicators. In addition, it is possible that the patients received the training but did not implement it for various reasons despite the phone reminders, which were beyond the control of the researchers.

5. Conclusion

This study evaluated the efficacy of a tailored care intervention program on some blood biochemical outcomes among Indonesian patients with diabetes. The results indicated that blood glucose level, triglyceride, and triglyceride glucose index decreased after three months of evaluation, but the changes were not statistically significant. On the other hand, the difference in cholesterol levels was significant but in a negative direction (i.e. increased). Tailored care intervention programs can potentially improve biochemical indicators, especially for blood glucose levels, triglycerides, and triglyceride glucose index. However, it seems that a follow-up study beyond three months is needed to be performed in the future to judge the applicability of the results.

Ethical Considerations

Compliance with ethical guidelines

The current study was approved by Indonesia Centre for Health Resources and Services Research and Development (Registry No.: INA-KFQZKG). The study was given the code of approval by the Institutional Review Board No. 232/EA/KEPK-BUB-2020 to safeguard the participants' human rights. After receiving an explanation of the study from the researchers and signing an informed consent, the participants were encouraged to participate. The data were coded anonymously for the questionnaire construction and data analysis. The participants were given the researchers' phone numbers and informed they could withdraw from the study without facing any repercussions.

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Authors' contributions

Conceptualization and data interception: All authors; Study design, writing the original draft and data evaluation: Satriya Pranata; Supervision: Shu-Fang Vivienne Wu; Final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

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