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THE EFFECT OF BEACH SAND HEAT THERAPY ON IMPROVING ABI VALUE OF TYPE-2 DIABETES MELLITUS PATIENTS

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Abstract

Background: The global incidence of Type-2 Diabetes Mellitus (Type-2 DM) represents a significant risk. Peripheral arterial disease (PAD) is well recognised as the primary etiological factor contributing to the development of diabetic ulcers, a matter of considerable concern. The assessment of Peripheral Arterial Disease (PAD) can be conducted by the evaluation of the Ankle Brachial Index (ABI). Three strategies exist for mitigating peripheral artery disease (PAD): counselling, medication, and foot care. Additional forms of foot therapy, such as applying the application of heated beach sand, have been developed. **Objective:** This aim to evaluate the effect of beach sand heat theraphy on type-2 DM patients' ABI levels. **Methods:**The research utilized a quasi-experimental design. This research was done between July 1 and 31, 2022. The research sample consisted of thirty replies, as chosen by the researchers. Each respondent was divided into two separate groups. One group receiving therapy and the other serving as a control. The theraphy group can get beach sand heat therapy twice a week for 30 minutes with hot sand between 40 and 45 ° C. for four weeks. **Results:** The results indicated that beach sand heat therapy had an effect on the ABI value of type-2 DM patients. The Tm-test statistic (Wilcoxon) showed p-value = 0.000 (<0.05) it was found that the Ankle Brachial Index (ABI) value after the intervention experienced improvement towards normal from 0.826 to 0.934. **Conclusion:** The beach sand heat treatment is particularly effective for enhancing the peripheral circulation of type-2 DM patients with PAD. It is hoped that this hot beach sand can be developed into an alternative therapy in the form of a product/tool so that it can be used anytime and anywhere and for respondents to be able to continue this therapy without neglecting blood sugar levels.

Keywords: Type-2 DM, PAD, ABI, therapy, beach sand

INTRODUCTION

Type-2 diabetes mellitus (DM) is currently a global health problem. The prevalence of Type-2 DM in society keeps on increasing, with the American Diabetes Association recording 415 million Type-2 DM patients in 2015 and projecting 642 million Type-2 DM patients in 2040 (Kshanti et al., 2019). The incidence of type-2 diabetes in Indonesia shows a persistent upward trend on an annual basis. Based on the Indonesian Basic Health Research (Riskesdas) findings, there has been an observed increase in the prevalence of type-2 diabetes mellitus (DM) from 6.9% in 2013 to 8.5% in 2018. This rise in prevalence corresponds to a total of 22.9 million individuals diagnosed with type-2 DM over the period above. Type 2 diabetes mellitus (DM) ranks sixth among non-communicable diseases (NCDs). Numerous factors contribute to the increasing prevalence of Type-2 DM, including lifestyle changes, obesity, physical inactivity, medication usage, getting older, pregnancy, smoking, genetic inheritance, and stress (Damayanti, 2015). In the province of West Sumatra, the prevalence rate was recorded as 1.1% in 2013, which increased to 1.3% in 2018 (Rikesda, 2018). In the Padang Pariaman District, there was an observed increase in the incidence rate from 1316 cases in 2018 to 1951 cases in 2019. There was a notable increase in the number of issues within the Ulakan Tapakis subdistrict, rising from 113 points in 2020 to 234 topics in 2021. As per the statements provided by PTM authorities from the Ulakan Tapakis Health Center, it has been observed that most individuals diagnosed

with Type-2 Diabetes Mellitus exhibit inadequate control over their condition. One contributing factor is the individual's aversion towards medication consumption.

Uncontrolled hyperglycemia can result in vascular dysfunctions such as Peripheal Arterial Disease (PAD). This condition frequently occurs without the patient's knowledge. This PAD may result in atherosclerosis and arterial insufficiency in the lower extremities. Symptoms include discomfort and trouble doing activities. According to Setiati, Siti; Idrus, Alwi; Aru W Sudoyo, 2016, many factors affect peripheral vascularization, including age, smoking, hypertension, dyslipidemia, and a lengthy history of diabetes.

The most prevalent cause of diabetic ulcers is PAD. Around 15% of diabetics may develop diabetic foot ulcers. 25% of ulcers must be amputated, and 50% are infected (Dinker R Pai, 2013). PAD assessment takes place by assessing the ankle brachial index (ABI). ABI is a non-invasive study of blood vessels and a straightforward tool for diagnosing peripheral vascular disorders.

These issues are avoidable if appropriate preventative, control, and treatment measures are implemented (Mahdavi et al., 2013). DM sufferers must also adhere to type-2 DM control measures, including education, diet, exercise, and foot care (Sidartawan, Soegondo; Pradana, 2009). One aspect of foot care is frequent foot excretion. This activity can enhance the ABI of type-2 DM patients (Hidayati et al., 2022). In addition to participating in physical exercise, utilising sand beaches as a natural resource can be used for alternative therapeutic purposes. The previous research demonstrated a correlation between physical activity and domain of quality of life. In addition, improved quality of life has emerged as an essential outcome measure in chronic health conditions (Zuriati, 2023).

According to Padma et al., 2020, sandromatherapy has a substantial effect on decreasing the intensity of musculoskeletal pain. According to Maitirouzi et al., 2017, the sand therapy had a positive effect on the volume distribution of the bony layer and the mechanical properties of the femur of osteoarthritis rabbits. These three trials utilized beach sand as an alternative therapy, however the researchers did not explain the use of beach sand heat therapy for type-2 DM. This study aims to demonstrate if beach sand heat therapy may help enhance ABI values in type-2 DM patients from Kenagarian Tapakis, Ulakan Tapakis District, and Padang Pariaman Regency.

METHOD

The research method employed is a quasi-experimental pre- and post-test design with a control group. This study's sample consisted of 30 Type-2 DM patients from the Ulakan Tapakis Regency. The sample criteria are respondents who have signed a declaration indicating their willingness to participate, the patient's ABI value is <0.90, does not suffer from diabetic ulcers and can communicate well.

This research was carried out in July 2022. Tiram Tapakis Beach, Ulakan Tapakis Regency, Padang Pariaman was the site of the study. The study was done by comparing the ABI values of the control and intervention groups. The intervention group was administered beach sand heat treatment, but the control group was not, although their activities were observed. The intervention group had therapy twice per week for four weeks, and an ABI value is measured at the conclusion of therapy. Every treatment lasts 30 minutes.

RESULTS AND DISCUSSION

This research was conducted in Ulakan Tapakis Regency, Padang Pariaman with a total of 30 respondents. The research location is in Oyster Beach. This research was carried out for 1 month, from 1-31 July 2022. Respondents in this study were Type-2 DM Patients. The following is a description of the results of the research that has been carried out by researchers.

Table 1: Distribution of characteristics and equality of research respondents (n = 30)

Variable	Category	Intervention		Control	
		Total	%	Total	%
Age	50-55	2	13,3	3	20
	56-60	3	20	1	6,7
	> 60	10	66,7	11	76,3
Gender	Male	4	26,7	6	40
	Female	11	76,3	9	60
Education	Elementary School	11	76,3	6	40
	Junior High School	0	-	2	13,3
	Senior High School	4	26,7	5	33,4
	University/College	0	-	2	13,3
Employement	Retirement	2	13,3	3	20
	Private Sector	2	13,3	2	13,3
	Farmer	1	6,7	2	13,3
	Fisherman	0	-	1	6,7
	Housewife	9	60	5	33,4
Duration of suffering from DM	< 5 years	4	26,7	2	13,3
	> 5 years	11	76,3	13	86,7
Other illnesses suffered	Hypertension	6	40	2	13,3
	Cataract	0	-	1	6,7
	Thyroid Tumor	0	-	1	6,7
Control frequency to health services	Always	2	13,3	0	-
	Sometimes	12	80	13	86,7
	Rarely	1	6,7	2	13,3
	Never	0	-	0	0

Based on table 1 regarding the characteristics of the respondents, it is known that of the 30 respondents, the majority in the intervention group were the age group > 60 years, namely 10 respondents (66.7%). Meanwhile, in the control group, the majority were also aged > 60 years, with 11 respondents (76.3%). Based on gender, it was known that of the 15 respondents in the intervention group who were female, there were 11 respondents (76.3%), this was the same as the control group. Based on recent education, most of the education in the intervention group was elementary school, with 11 respondents (76.3%), as well as the control group, most of whom were elementary school, with 6 respondents (40%). For most of the respondents' work with housewives, from the intervention group housewives 60% and the control group with housewives 33.4%. In terms of duration of DM disease, it turned out that more than half of the respondents had DM for > 5 years, with 76.3% in the intervention group and 86.7% in the control group. Based on the control to health services, it turned out that the average respondent sometimes did it, with details of 80% in the intervention group and 86.7% in the control group. Based on other diseases that the respondents suffered from, most of the respondents in the intervention group had a history of hypertension, as many as 6 respondents (40%). Whereas in the control group also had a history of hypertension as many as 2 people (13.3%).

The results of the characteristics of respondents by age category showed that the ages in the two groups had almost the same variation, in the intervention group and the control group were in the age range above 60 years. The aging process that takes place after the age of 30 years results in anatomical, physiological and biochemical changes. Adjustments at the cellular, tissue, and organ levels, which might alter homeostatic functioning, begin at the cellular level (Mensah et al., 2015). All components of the body undergo changes including pancreatic beta cells which produce the hormone insulin, target tissue cells which produce glucose, the nervous system, and other hormones that affect glucose levels. Age > 50 years can increase the incidence of type-2 DM because aging causes decreased insulin sensitivity and decreased function for glucose metabolism (Suiraoka, 2012). This is supported by research of Kekenusa et al., 2018, there is a significant relationship between age and the incidence of Type-2 DM (p=0.000) with an Odds Ratio value of 7.6. It is stated that age = 45 years have 8 times the risk of developing diabetes mellitus than people aged < 45 years. According to Adi S, 2014, the elderly undergo an increase in insulin production from the liver (hepatic glucose production), insulin retention, and reduced insulin secretion due to aging and death of pancreatic beta cells as compared to younger individuals. The age factor is intimately associated with the deterioration of physiological processes, particularly pancreatic function. The findings of the investigation indicate that glucose intolerance increases with age, particularly beyond 45 years of age. The prevalence of diabetes, reduced glucose tolerance, and consequences of diabetes mellitus, such as impaired lower extremities blood circulation, rises with age (Black, J. M., & Hawks, 2016).

The normal aging process renders elderly blood vessels more vulnerable to atherosclerosis, resulting in peripheral circulation problems. The inflammatory cells, endothelial cells, and vascular smooth muscle cells of elderly individuals are different from those of younger individuals (Wang et al., 2012). According to the same investigation resuts of Black, J. M., & Hawks, 2016, The aging process alters the blood vessel walls, consequently affecting the delivery of oxygen and nutrients to the tissues. Due to cellular growth and fibrosis, the intima layer becomes thicker. Collagen accumulates in both the intima and media layers, and the fibers of the media layer are calcified, thin, and sliced. These modifications result in peripheral vascular rigidity. The aging process causes changes in the walls of blood vessels, which might impact the Ankle Brachial Index (ABI) score.

The intervention group had a history of hypertension that was greater than that of the control group, according to the results of the characteristics of respondents with additional ailments that they suffered. A history of hypertension can influence the average outcome of an increase in the Ankle Brachial Index (ABI) value since hypertension has an effect on a reduction in the ABI value.

Hyperglycemia in type-2 DM patients allows for the development of arteiosclerosis, which disrupts blood flow to the heart owing to increased blood viscosity. As a result, the heart's workload to pump blood throughout the body increases, and hypertension can develop over time. (Black, J. M., & Hawks, 2016).

This situation was also reported by Whelton et al., 2018. Age and a history of diabetes greatly increase the incidence of hypertension. It is supported by the research of Jelantik, 2014 that to 50 respondents of type-2 DM patients, it was found that 88% of respondents had hypertension and 12% of respondents did not suffer from

hypertension and based on the Contingency C coefficient test, it was found that the value of p = 0.000 (p <0.05) means that there is a significant relationship between diabetes and hypertension. In addition, research results of Valliyot et al., 2013, showed that people who have a history of hypertension have a 5 times risk of suffering from type-2 DM compared to people who do not have a history of hypertension. In the study it was also found that 40% of the respondents suffered from hypertension.

The features of the respondents about the amount of time they had diabetes mellitus revealed that both the intervention group and the control group had a lengthy history of diabetes, namely > 5 years. The duration of diabetes mellitus might raise the likelihood of complications. In individuals with type-2 DM, persistent hyperglycemia produces pathological alterations in blood vessels, including endothelial cell dysfunction and smooth muscle cell abnormalities. This decreases the amount of vasodilators in the endothelium, narrowing the blood vessel lumen. Angiogenesis contributes to the pathogenesis of vascular atherosclerosis by causing inflammation, thrombosis, arterial stiffness, and altered blood flow control.

In addition to disturbances in vasodilator function, hyperglycemia in diabetes is also associated with an increase in thromboxane A2, a vasoconstrictor and platelet aggregation agonist, which increases the risk for plasma hypercoagulability and the potential for changes in the vascular extracellular matrix to cause arterial lumen stenosis. The development of endothelial dysfunction in DM is also connected with additional risk variables, including body mass index, physical activity, obesity, diabetes mellitus in the family history, and glucose tolerance. The lumen of blood arteries is compromised by a sustained rise in blood sugar levels. Disruption to the blood vessel lumen will restrict peripheral circulation, resulting in a decrease in the Ankle Brachial Index and the development of diabetic ulcers (Black, J. M., & Hawks, 2016).

This situation is also proven by Zúñiga-Martínez et al., 2017 who looked at the medical records of 108 patients with type-2 DM evaluated. Data obtained on average: blood glucose (162.3 ± 73.10 mg/dl), glycated hemoglobin (HbA1c = 7.64% ± 1.77%), cholesterol (189.28 ± 35.25 mg/dl), triglycerides (189.11 ± 87.76 mg/dl), Systolic Blood Pressure (SBP = 119.69 ± 14.95 mmHg), Diastolic Blood Pressure (DBP = 77.15 ± 9.55 mmHg) and Blood Pressure Medium (MBP = 91.36 ± 9.89 mmHg). Then correlate the variable HbA1c with symptoms of vascular injury. In the results, a correlation was found between sensitivity dysfunction and HbA1c with statistical significance p = 0.01, and Kendal correlation coefficient w = 0.01, other metabolic control parameters did not correlate with symptoms of vascular injury. Conclusion: It is remarkable that sensitivity dysfunction is a symptom of poor lower extremity vascularization caused by functional disturbances and structural changes in the peripheral nerves of diabetic patients.

The findings of the features of respondents with control frequency points to health services revealed that 80 % of respondents in the intervention group and 86.7 % of respondents in the control group fell into the category of occasionally controlling health services. In this instance, they will have control over any complaints. It was also discovered by Whelton et al., 2018 with the 2009 to 2012 NHANES prevalence estimates for men and women, respectively, being 80.2% and 85.4% for awareness, 70.9% and 80.6% for treatment (88.4% and 94.4% in those who were conscious), 69.5% and 68.5% for controls in those who were treated, and 49.3% and 55.2% for overall controls in adults with hypertension, respectively. Control rates were

consistently higher in women than men (55.3% versus 38.0% in 2009–2012). The NHANES experience undermines awareness, treatment, and disease control.

Type-2 DM is a metabolic condition characterized by hyperglycemia caused by reduced insulin production by pancreatic beta cells and/or impaired insulin activity (insulin resistance). Long-term uncontrolled hyperglycemia makes diabetes mellitus patients prone to the development of a variety of additional diseases. In addition, according to Johnson et al., 2019, Pasien dengan diabetes tipe 2,rata-rata dengan komorbiditas hipertensi. Pemantauan glukosa adalah kunci untuk pencapaian pengendalian glikemia pasien diabetes. Glucose monitoring enables patients to evaluate their unique response to treatment and determine if glycemic goals are being met. In addition to glycemic targets, diabetes management must incorporate food, exercise, and lifestyle. All patients should be evaluated for diabetic peripheral neuropathy at diagnosis of type-2 DM, five years after diagnosis of type-1 DM, and annually afterwards. 50% of asymptomatic diabetic peripheral neuropathy.

Every time a patient enters a health care institution, a glucose monitoring check and assessment of peripheral neuropathy are performed. This situation can reveal early disease problems. If it is not identified and preventative foot care is not performed, more issues are likely.

Table 2: Distribution of mean Ankle Brachial Index (ABI) values in diabetes mellitus patients before and after intervention in both groups (n = 30)

Variable	Intervention Group			Control Group		
	Mean	Min-Max	CI	Mean	Min-Maks	CI
Pre	0,826	(0,76-0,87	0,0667-0,1081	0,841	(0,81-0,89)	-0,0022-0,0142
Post	0,934	(0,84-1,00)	0,0867-0,1299	0,847	(0,81-0,91)	-0,0022-0,0142

Table 2 shows that there was an improvement in the Ankle Brachial Index (ABI) value in a better direction after hot beach sand therapy in the intervention group compared to the control group.

Table 3: Changes in Ankle Brachial Index (ABI) values of diabetes mellitus patients in the intervention group (n = 30)

Group	Ankle Brachial Index value measurement		*P*
	Mean	SD	
Pre	0,826	0,029	0,000
Post	0,934	0,051	

Based on table 3, it was found that the Ankle Brachial Index (ABI) value after the intervention had improved towards normal from 0.826 to 0.934. The statistical results of the Tm-test (Wilcoxon) show p-value = 0.000 (<0.05), which means that there is an effect of heat applied to beach sand on the value of the Ankle Brachial Index in patients with type-2 DM.

Table 4: Changes in the value of the Ankle Brachial Index (ABI) in patients with diabetes mellitus in the control group (n = 30)

Group	Ankle Brachial Index value measurement		*P*
	Mean	SD	
Pre	0,841	0,021	0,144
Post	0,847	0,028	

Based on table 4, it was found that the Ankle Brachial Index (ABI) value of the control group did not improve towards normal. The results of statistical tests showed p-value

= 0.144 (> 0.05), it can be concluded that Ho is accepted that there is no effect of improving the Ankle Brachial Index value towards normal in patients with type-2 DM between the initial treatment and the end of treatment in the control group.

In patients with type-2 DM, an increase in blood glucose causes an increase in blood viscosity, resulting in a reduction in blood flow and an increase in platelet aggregation; this promotes the formation of microthrombus and microvascular blockage, which is linked to the development of microvascular and macrovascular complications such as PAD.

According to Takahara, 2021, In situations of diabetes, PAD, particularly Chronic Limb-Threatening Ischemia (CLTI) or officially Critical Limb Ischemia (CLI), has a significant clinical impact. CLTI in instances of diabetes mellitus increases the clinical severity of non-healing ulcers and gangrene due to chronic ischemia (ie, Fontaine stages III and IV or Rutherford categories 4 through 6). Prior to revascularization, a number of steps may be necessary in health care and clinical settings, such as regular monitoring of ischemia risk and control of diabetes.

According to Aboyans et al., 2018, the therapy strategy for PAD patients consists of two components. The first step is to treat the unique symptoms and hazards associated with each location and lesion. A second element of these patients' care is linked to an increased risk of cardiovascular events. It is more prevalent in elderly people, namely those with diabetes. Prevention is of the highest significance, and multidisciplinary management is required. Best medical therapy (BMT) includes both pharmaceutical and non-pharmacological treatments, such as quitting smoking, a good diet, weight loss, and regular exercise.

Hot sand treatment is one of the nonpharmacological techniques to therapy. This treatment has been extensively developed. This therapy is a complementary treatment done by many individuals in coastal regions, including Aceh, Bengkulu, West Java, Bali, and Japan. Hot sand beach therapy is a beneficial alternative treatment for human health. Heat treatment that radiates at 420^{o}C provides benefits for the body, including the elimination of heavy metal elements through the sweat glands and fat glands as well as the elimination of poisonous chemicals in the body owing to chemical pollution. In addition, it can eliminate lactic acid, fatty and fatty acids, sodium ions, uric acid, and other chemicals that contribute to weariness and other disorders. In addition, it regulates the autonomic nerves, avoids irregularities of the sensory nerves, restores bodily functions, regulates the tissue systems of the body, supplies active energy, and enhances the body's regenerative capacity (Dehghan & Farahbod, 2014 & Szymanski, 2001)

Dominant sand is composed of ferromagnetic (magnetic) minerals on average 66.20% with a composition range of 25.04 to 74.83% and composed of diamagnetic minerals (non-magnetic) on average 33.80% with a composition range of 25.17 up to 74.96%. Generally metals have greater heat conductivity than non-metals (Shankar, 2017). According to Cahyono et al., 2013, Magnetic mineral composition (66.20% on average) which is more abundant than non-magnetic minerals and the dominance of fine sand grain size (0.425 - 0.075 mm) affect the heat emission temperature of the sand (41.4 – 420^{o}C). It is recommended to optimally use hot sand for therapy at 16.00 - 18.00 WIB with sunny weather conditions.

This study was done twice every week for a duration of four weeks. Each workout is 30 minutes in length. After the operation, the Ankle Brachial Index (ABI) score increased from 0.826 to 0.934, which is closer to the normal range. The statistical findings of the Tm-test (Wilcoxon) reveal a p-value of 0.000 (<0.05), indicating that heat applied to beach sand has an influence on the Ankle Brachial Index value in patients with type-2 DM. This is owing to the sand's ability to transfer heat via the skin and blood vessels. This situation can eliminate plaque in blood vessels if, after 30 minutes, the respondent's feet are stacked while they are wet/sweaty and their feet are opened. Mohebi et al., 2018 also proved the benefits of hot sand and hot salt for the treatment of Laow Back Pain (LBP), revealing that topical treatment with hot salt and hot salt can have a significant effect on the perception of LBP compared to the control group.

The same investigation results were also found by Fu et al., 2014, During Uyghur sand therapy, the gradient increased, indicating a quicker blood flow. Blood flow in the knee's arteries is exclusively laminar. Flow velocity varies, being slowest adjacent to the vessel wall and fastest adjacent to the vessel stem. After undergoing sand treatment, Uyghurs had better blood flow. Before and after, arterial blood flow displays a pronounced pressure gradient. Both vascular diameter and blood flow velocity increased statistically significantly during Uyghur sand treatment (diameter enlarged and velocity increased). The treatment had a greater impact on blood flow velocity than on vessel diameter. An essential component of Uyghur sand treatment is heating. During heating, it can aid to warm human tissue, raise oxygen saturation, increase heart rate, and widen blood vessels. In addition, heat can improve the blood flow velocity of the lower leg knee joint arteries of the repaired area, which assists in the treatment of illness.

Research by WU & RONGCHANG FU, 2022 proved that sand therapy can slow the development of atherosclerosis. They investigated the effect of sand therapy on fluid dynamics in the popliteal artery based on the multiphase Euler model. 58 samples were utilized in this investigation. The impact of sand treatment on the hemodynamics of the popliteal artery (POA) was studied to explain its mechanism in atherosclerotic physiotherapy. Before and after sand treatment, the hemodynamic parameters of POA were statistically evaluated. The POA bifurcation was modeled using a three-dimensional finite element technique. Plasma, red blood cells (RBC), and white blood cells are considered three phases of blood in this study (WBC). Blood flow velocity, wall shear stress (WSS), and blood cell distribution were determined using computational fluid dynamics (CFD) before to and during sand treatment. The findings of this study show that sand treatment can decrease blood vessel eddies and reflux. The largest rise in blood's axial velocity is 34.38 percent. Blood cells gradually migrated away from the vessel wall and toward the vessel axis as the maximum WSS rose by 22.82 Pa. During sand therapy, the decrease of eddy and reflux, as well as the enhancement of blood axial velocity, are advantageous for lowering the buildup of cholesterol and other substances, consequently minimizing the formation of atherosclerotic plaques and lipid streaks. In regions with low WSS, the rise in WSS reduces the potential for arteries to thicken. The transfer of blood cells to the axis of the blood arteries can lower the risk of thrombosis caused by blood cells adhering to the vessel walls.

According to Dacheva & Seleva, 2020, Seawater and sand kinesi exercises have been shown to have therapeutic benefits on the human body. Psammotherapy, often known as sand therapy, began in ancient Egypt. Using beach sand as an alternative therapy offers a therapeutic and calming impact. This therapy is beneficial for the rehabilitation of fractures, injuries to the musculoskeletal system, arthritis, radiculitis, and neuralgia.

CONCLUSION

The improvement of normal collar ABI values (> 0.9) with p = 0.000 demonstrates that beach sand heat treatment is particularly effective for enhancing the peripheral circulation of type-2 DM patients with PAD. This treatment is quite simple and does not demand costly expenses. Other diabetes control methods should not be neglected.

Ethics Approval And Consent To Participate

The study obtained ethics approval and ensured that participants provided informed permission prior to their involvement. Prior to the commencement of the study, the researchers obtained ethical clearance from the Internal Review Board of Universitas Negeri Padang (No.24.01/KEPK-UNP/III/2022). The subjects provided their consent upon being recruited. The study offered voluntary participation, allowing individuals the freedom to withdraw at any time without incurring any penalties.

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