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Kepatuhan Kontrol Tekanan Darah pada Lansia dengan Hipertensi

Compliance with Blood Pressure Control in the Elderly with Hypertension

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Ringkasan: Hipertensi merupakan penyakit yang masih menjadi masalah besar tidak hanya di dunia tetapi juga di Indonesia, kasus hipertensi terus meningkat .seiring dengan berkembangnya zaman. Penyakit hipertensi.disebabkan oleh beberapa faktor seper-ti pola hidup yang terkait dengan .kebiasaan konsumsi makan yang.tidak sehat, perokok, kurang berolahraga, gen, serta faktor stress. Melakukan kontrol tekanan darah merupakan salah satu cara untuk mencegah terjadinya penyakit tekanan darah tinggi atau komplikasi dari penyakit tersebut. Tujuan penelitian ini adalah mengetahui gambaran kontrol tekanan darah pada lansia di panti werdha Al-Marhamah Tarakan Kalimantan Utara, dengan metode deskriptif sebanyak 18 re-sponden. Hasil di temukan sebanyak 13 responden (72%) megalami tekanan darah tinggi, dan 5 responden (28%) memiliki tekanan darah normal, dengan kepatuhan kontrol tekanan darah sebanyak 6 responden (33%) dan 12 responden (67%) tidak patuh kontrol tekanan darah. Dari hasil penelitian menunjukan bahwa ketidakpatu-han kontrol tekanan darah yang tinggi sehingga diperlukan adanya edukasi berke-lanjutan serta adanya educator terlatih dalam pelaksanaan pengukuran tekanan darah.

Abstrack : *Hypertension is a disease that is still a big problem not only in the world but also in Indonesia, hypertension cases continue to increase along with the development of the times. Hypertension is caused by several factors such as lifestyle related to unhealthy eating habits, smokers, lack of exercise, genes, and stress factors. Controlling blood pressure is one way to prevent high blood pressure or complications from the disease. The purpose of this study is to find out the picture of blood pressure control in the elderly at the Al-Marhamah Tarakan Nursing Home in North Kalimantan, with a descriptive method of 18 re-spondens. The results found that 13 respondents (72%) had high blood pressure, and 5 respondents (28%) had normal blood pressure, with 6 respondents (33%) and 12 respondents (67%) not complying with blood pressure control. The results of the study show that the inadequacy of high blood pressure control requires continuous education and the presence of trained educators in the implementation of blood pressure measurement.*

PENDAHULUAN

Lanjut usia atau kita kenal dengan lansia adalah seseorang yang berusia>60 tahun yang secara umum mengalami penurunan kondisi kesehatan, rentan terhadap penyakit, adanya keluhan fisik diakibatkan oleh berbagai factor dan lansia adalah individu yang sering sekali dianggap tidak produktif (Ratnawati, 2017).

Penuaan mempengaruhi fungsi organ tubuh, dan pada lansia, fungsi organ menurun. Ada beberapa faktor yang dapat mempengaruhinya. Ini termasuk faktor alam dan penyakit degeneratif yang diderita orang tua. Salah satu penyakit degeneratif dengan morbiditas dan mortalitas yang tinggi adalah hipertensi. Hipertensi merupakan salah satu dari 5 penyakit teratas yang ditemukan di Indonesia (Patriyani & Sulistyowati, 2020).

Komplikasi adalah hal yang sangat dikhawatirkan akibat adanya peningkatan tekanan darah yang tidak terkontrol, diantaranya jantung koroner, stroke, gagal ginjal, gangguan penglihatan sampai dengan kematian. Kematian akibat hipertensi menduduki peringkat teratas dari pada penyebab penyakit lainnya, di perkirakan pada tahun 2025 terjadi peningkatan sekitar 80% kasus akibat hipertensi (Ekarini, Ni Luh Putu, Heryati Heryati, 2019).

Terapi hipertensi pada lansia meliputi terapi obat dan non-obat untuk mencegah morbiditas dan mortalitas. Pengobatan farmakologis adalah penggunaan obat antihipertensi. Pengobatan nonfarmakologis dicapai melalui modifikasi gaya hidup seperti berhenti merokok, penurunan berat badan, pantang alkohol, kontrol diet, manajemen stres, olahraga, dan istirahat (Patriyani & Sulistyowati, 2020).

Kontrol Tekanan darah adalah kegiatan yang dilakukan pasien tekanan darah tinggi untuk mengontrol tekanan darah di pelayanan kesehatan, tetapi pasien tekanan darah tinggi hanya mengontrol perawatan kesehatan ketika tanda dan gejala muncul, bahkan jika terjadi komplikasi seperti stroke. (Martins et al., 2012). Tekanan darah diastolik adalah tekanan rendah yang terjadi saat jantung dalam keadaan istirahat. Tekanan darah biasanya dinyatakan sebagai rasio tekanan darah sistolik terhadap diastolik menggunakan nilai orang dewasa normal berkisar antara 100/60 hingga 140/90. Nilai tekanan normal rata-rata adalah 120/80 (Hirdayanti, 2017).

Peningkatan tekanan darah yang terus bertambah disetiap tahunnya, memberikan dampak buruk bagi kesehatan terutama pada lansia yang beresiko tinggi terpapar penyakit (Riskesdas, 2018), oleh sebab itu sangat diperlukan adanya edukasi tentang hipertensi untuk meningkatkan pengetahuan, kesadaraan akan pentingnya kontrol tekanan darah dipelayanan kesehatan terdekat sehingga dapat mengurangi dampak buruk dari penyakit hipertensi terhadap kesehatan lansia.

METODE

Jenis Penelitian

Jenis penelitian kuantitatif dengan desain penelitian deskriptif, deskrptif Artinya, penelitian yang berusaha menjelaskan dan menafsirkan sesuatu, seperti kondisi atau hubungan yang ada, pendapat yang berkembang, proses yang sedang berlangsung, hasil atau dampak yang terjadi, atau tren yang sedang berlangsung (Linarwati et al., 2016).

Lokasi dan Waktu Penelitian

Penelitian ini dilakukan pada bulan September sampai November tahun 2022 di panti Werdha Al-Marhamah Tarakan Kalimantan Utara.

Populasi dan Sampel

Populasi pada penelitian ini adalah seluruh lansia yang berada di panti werdha Al-Marhamah Tarakan sebesar 18 responden dengan teknik pengambilan sempel menggunakan total sampel.

Pengumpulan Data

Data pada penelitian ini merupakan data primer dimana data didapat dari kuesioner yang diisi oleh responden pada waktu penelitian yang sudah diminta persetujuannya. Kuesioner kepatuhan kontrol tekanan darah menggunakan kuesioner Hill Bone, kuesioner ini terdiri dari 14 pertanyaan dalam setiap pertanyaan terdapat 4 penilaian yaitu 1= tidak pernah, 2= kadang-kadang, 3=sering dan 4=selalu, jumlah skor minimum yaitu 14 dan maksimum yaitu 56 (Fauziah, 2019). Dalam penelitian Fauziah (2019) telah dilakukan uji validitas dan rehabilitas dan 14 pertanyaan kuesioner Hill Bone dinyatakan valid.

Pengolahan dan Analisis Data

Data yang terkumpul kemudian dilakukan perhitungan dengan total skor masing-masing komponen, apabila hasil perhitungan didapatkan jumlah skor 14 – 34 adalah nilai tidak patuh kontrol tekanan darah dan skor 35-56 adalah nilai patuh kontrol tekanan darah. Data selanjutnya dianalisis menggunakan distribusi frekuensi, Chi-Square.

HASIL

Tabel 1. Distribusi Frekuensi Karekteristik Demografi Berdasarkan Usia, Jenis Kelamin, dan Pendidikan Lansia (N=18)

Karekteristik Responden	Frekuensi (f)	Persentase (%)
Usia		
Lansia akhir (56-65 tahun)	2	11
Manula (>65 tahun)	16	89
Jenis Kelamin		
Perempuan	15	83
Laki-laki	3	17
Pendidikan SD		
SMP	13	72
SMA	5	28
Total	**18**	**100**

Pada kategori usia terlihat lebih banyak pasien berusia lansia manula (>65tahun) yaitu sebanyak 16 pasien (89%). Sebagian besar pasien berjenis kelamin perempuan yaitu sebanyak 15 pasien (83%) dan tingkat Pendidikan terbanyak adalah SD sebanyak 13 pasien (72%).

Tabel 2. Distribusi Frekuensi Sampel Berdasarkan Kepatuhan Kontrol Tekanan Darah pada Lansia (N =18)

Kepatuhan	Frekuensi (f)	Presentase (%)
Tidak Patuh	12	67 %
Patuh	6	33 %
Total	**18**	**100%**

The first hot plate test was carried out when the rats had not been induced by STZ-Na as T1 which would be used as a comparison with the retention time after experiencing hyperglycemia. The hot plate test was continued when the rats had diabetes, namely on the third

day and thereafter, they were repeated regularly every seven days. Measurements were stopped after the mice gave a significant decrease in pain response as a sign that neurotoxicity had occurred. According to Table 3, the results of the observations were processed using statistics to determine the significance of the decrease in retention time with the hot plate test.

Table 3. The changes of retention time average hot plate on day 1 to day 42 optimizing induction neuropathy and percentage of decrease retention time

Group	Day to-								Δ H42-H1	% Δ H42-H1
	1	3	7	14	21	28	35	42		
I	3.8 ±1.17	2.8 ±0.75	3 ±1.10	3.6 ±0.80	3 ±0.63	3 ±1.10	3.4 ±1.02	3[b] ±1.10	-0.80	-21.05
II	4 ±0.89	3 ±0.89	3.4 ±1.02	3.8 ±1.17	5 ±0.63	5.4 ±0.49	5.6 ±0.49	5.4[a] ±0.49	1.40	35.00
III	3.4 ±1.02	3.4 ±1.02	4 ±0.89	2.8 ±0.75	5.6 ±1.02	9.6 ±0.80	13.6 ±1.36	14.4[a] ±1.36	11.00	323.53
IV	3.4 ±1.02	3.2 ±0.75	3.6 ±0.80	3.2 ±1.17	9.4 ±0.49	12 ±0.89	13.6 ±1.02	16.2[a] ±0.75	12.80	376.47

Information: Group I: Normal rat group, Group II: Group of malnourished rats, Group III: Normal rat group + Streptozotosin – Nikotinamid, Group IV: malnourished rat group + Streptozotosin – Nikotinamid. *Reading One Way Anova: a. significantly different from the normal.

Measurement of rat blood sugar levels in the Moringa leaf ethanol extract test was conducted to determine whether Moringa leaf ethanol extract can lower blood sugar levels, as well as a parameter for the improvement of neuropathic nerve cells due to diabetes. Before the STZ-Na induction, the rat's blood sugar level was measured as T1 which will then be used as a comparison to whether the STZ-Na induction was successful. On the third day, sugar levels were measured again as T1 and then regularly measured every 7 days to see if after being given extract treatment, there would be a decrease in sugar levels as an indicator of neuroprotector activity of Moringa leaf ethanol extract.

Table 1. The changes in average blood sugar levels on the 1st day to the 49th day of the Moringa leaf ethanol extract test and the percentage decrease in blood sugar levels

GROUP	Day to-									Δ H49-H1	% Δ H49-H1
	1	3	7	14	21	28	35	42	49		
I	70.2 ±7.52	69.6 ±7.34	81.2 ±11.3	81 ±10.06	80 ±7.82	81.4 ±7.81	79.6 ±7.76	81.2 ±6.62	81[a] ±6.07	10.80	15.38
II	77 ±10.33	76 ±10.53	78 ±8.12	77.8 ±7.78	75.6 ±6.62	76.4 ±4.5	76 ±4.56	75.8 ±4.75	75.6[a] ±4.27	-1.40	-1.82
III	81.2 ±6.05	216.2 ±4.26	208 ±11.7	212.8 ±9.58	214.4 ±9.48	209.2 ±8.23	208 ±7.56	205.4 ±7.14	203.6[b] ±8.01	122.40	150.74
IV	84.6 ±7.81	212.4 ±7.42	213.4 ±5.78	212.8 ±6.49	210.8 ±5.53	210.2 ±5.71	163 ±5.1	149.8 ±8.7	155.4[b] ±1.85	70.80	83.69
V	81.6 ±8.55	217.2 ±4.92	217 ±4.34	213.8 ±5.19	210.2 ±5.04	206.6 ±5.35	163.6 ±3.26	155.8 ±4.53	156.2[b] ±2.32	74.60	91.42

GROUP	Day to-									Δ H49-H1	% Δ H49-H1
	1	3	7	14	21	28	35	42	49		
VI	84.2 ±11.09	215.4 ±3.61	215.4 ±3.67	215.4 ±3.5	208.4 ±4.63	208 ±6.96	189.6 ±4.5	183.2 ±5.56	178.8[b] ±6.46	94.60	112.35
VII	75.4 ±9.65	216.2 ±3.82	218 ±3.58	216.4 ±3.44	217.8 ±2.79	215.6 ±2.33	169.8 ±1.72	158.4 ±3.07	155.6[b] ±4.5	80.20	106.37
VIII	76.8 ±9.79	215.2 ±5.78	216 ±5.1	214.6 ±3.44	214 ±6.32	211.8 ±6.62	167.4 ±1.5	159.4 ±3.38	153.4[b] ±4.13	76.60	99.74

Information: Group I: Normal rat group, Group II: Group of malnourished rats, Group III: malnourished rat group + Streptozotosin – Nicotinamide, Group IV: Glilibenklamid rat group + Streptozotosin – Nicotinamide, Group V: Glibenklamid+Vit. B_6 rat group+ Streptozotosin – Nicotinamide, Group VI: Ekstrak Etanol moringa leaves 50 rat group + Streptozotosin – Nicotinamide, Group VII: Ekstrak Etanol moringa leaves 100 rat group+ Streptozotosin – Nicotinamide, Group VIII: Ekstrak Etanol moringa leaves 150 rat group+ Streptozotosin – Nikotinamid; *Pembacaan One Way Anova: a. significantly different toward the negative group, glibenclamid, glibenclamid+vitB6, extract 50mg, extract 100 mg, extract 150 mg, b. significantly different toward normal group, normal malnutrition.

The results of measuring blood sugar levels showed that rats in groups 7 and 8 experienced a decrease in blood sugar levels with almost the same percentage as groups 4 and 5, which can be seen in Table 4. This showed that group 7 was given 100 mg of Moringa leaf ethanol extract and group 8 was given Moringa leaf extract, 150 mg had a decrease that was almost close to group 4, namely the positive control of glibenclamide and the positive group of glibenclamide + vitamin B6. Meanwhile, group 6 which was given 50 mg Moringa leaf ethanol extract, was able to reduce blood sugar levels but was not better than the glibenclamide positive control group or the glibenclamide + vitamin B6 positive control group.

The first measurement of tail flick retention time was carried out before the rats were induced with STZ-Na as T1, then performed regularly every 7 days until the rats were neurotoxic. After the rats were declared to be neurotoxic, the rats were given ethanol extract of Moringa leaves and measured again every 7 days to see if there was an increase in the speed of retention time in the tail flick test. The existence of a neuroprotector effect on the ethanol extract of Moringa leaves can be seen if after administration of the extract, there is an increase in retention time. The faster the rats flicked their tails, indicating the repair of nerve cells damaged by hyperglycemia.

Table 5. The changes of time average retention tail flick on day 1 to day 49 extract test and percentage of decrease retention time

GROUP	Day to -									Δ H49-H1	% Δ H49-H1
	1	3	7	14	21	28	35	42	49		
I	8.6 ±1.02	7.8 ±0.75	8 ±0.63	8.6 ±1.02	8.6 ±0.49	8.8 ±0.75	8 ±0.89	8.2 ±0.75	8.2 ±0.9	-0.60	-6.98
II	8.6 ±0.8	7.2 ±0.75	8 ±0.89	7.6 ±1.02	8 ±0.89	9.2 ±0.75	9.4 ±0.49	9.8 ±0.75	9 ±0.63	0.40	4.65
III	7 ±1.1	7 ±1.1	6.6 ±1.02	5.4 ±1.02	11.2 ±1.47	13.6 ±1.5	16.6 ±0.49	19 ±0.89	18 ±0.89	11.00	157.14

GROUP	Day to -									Δ H49-H1	% Δ H49-H1
	1	3	7	14	21	28	35	42	49		
IV	5.4 ±0.49	6.2 ±0.4	6.4 ±0.49	5.4 ±0.49	10 ±0.89	14.2 ±0.75	13.8 ±0.75	9.8 ±0.75	9 ±0.63	3.60	66.67
V	5.4 ±1.02	5.8 ±0.75	6.6 ±1.02	6.6 ±0.49	9.4 ±0.49	14.2 ±0.75	12.6 ±0.49	8.2 ±0.4	7.2 ±0.75	1.80	33.33
VI	5 ±0.63	5 ±0.63	6 ±0.63	5.4 ±0.49	9 ±0.63	15 ±0.63	14.8 ±0.75	13 ±1.1	9.6 ±0.49	4.60	92.00
VII	5.4 ±0.8	5.8 ±0.75	6.2 ±0.75	5 ±0.71	8.8 ±0.75	13.8 ±0.75	13.2 ±0.4	10 ±0.63	8.8 ±0.4	3.40	62.96
VII	5 ±0.63	5.6 ±0.8	5.8 ±0.4	5.2 ±0.4	9 ±1.1	14.6 ±0.49	13.6 ±0.49	9 ±0.63	6.6 ±0.49	1.60	32.00

Reading One Way Anova: a. significantly not different toward the normal group.

The hot plate test on the extract treatment was carried out with the aim of seeing whether the ethanol extract of Moringa leaves had a neuroprotective effect on rats that had experienced neurotoxicity. The first hot plate test was performed before the rats were induced by STZ-Na, the retention time was recorded as T1. Furthermore, the hot plate test was carried out on the third day after STZ-Na induction when the rats had experienced hyperglycemia, then the test was carried out regularly until the rats were neurotoxic. After experiencing neurotoxicity, the rats were given ethanol extract of Moringa leaves and then the hot plate was tested again to determine whether there was an increase in retention time against hot plate thermal stimulation, according to Table 6.

Table 6. The changes of time average retention hot plate on day 1 to day 49 extract treatment and percentage of decrease retention time

GROUP	Day to-									Δ H49-H1	% Δ H49-H1
	1	3	7	14	21	28	35	42	49		
I	3.8 ±1.17	2.8 ±0.75	3 ±1.10	3.6 ±0.80	3 ±0.63	3 ±1.10	3.4 ±1.02	3 ±1.10	2.6[a] ±0.80	-1.20	-31.58
II	4 ±0.89	3 ±0.89	3.4 ±1.02	3.8 ±1.17	5 ±0.63	5.4 ±0.49	5.6 ±0.49	5.4 ±0.49	4.8[ab] ±0.75	0.80	20.00
III	3.4 ±1.02	3.2 ±0.75	3.6 ±0.80	3.2 ±1.17	9.4 ±0.49	12 ±0.89	13.6 ±1.02	16.2 ±0.75	15.6 [b] ±1.02	12.20	358.82
IV	2.6 ±0.80	2.6 ±0.80	4 ±0.89	3.4 ±0.49	9 ±0.63	11.8 ±0.75	11.4 ±0.49	9.6 ±0.49	8.8[ab] ±0.40	6.20	238.46
V	2.6 ±0.49	2.6 ±0.80	4 ±0.63	3.4 ±0.49	8.6 ±0.49	13.4 ±0.49	12 ±0.63	7.8 ±1.17	4.8[ab] ±0.75	2.20	84.62
VI	2.6 ±0.49	3.2 ±0.75	4.6 ±0.49	3.8 ±0.40	9 ±1.10	13.2 ±0.75	12.6 ±0.49	10.8 ±0.40	10[ab] ±0.63	7.40	284.62
VII	2.8 ±0.75	4 ±0.63	4.4 ±0.49	4.6 ±0.49	9.6 ±0.80	12.8 ±0.75	11.4 ±0.49	10.2 ±1.17	7.8[ab] ±0.75	5.00	178.57
VII	2.6 ±0.49	4.4 ±0.49	4.4 ±0.49	5.2 ±5.20	9.6 ±0.80	13 ±0.63	11.2 ±0.75	9 ±0.63	5.4[ab] ±0.49	2.80	107.69

*Reading One Way Anova: a. significantly different toward normal group, b. significantly different toward malnutrition group STZ-NA.

The results of the hot plate test on the rat group with the extract treatment showed that the rat group VI experienced an increase in retention time, but it was not better than groups IV and V. This means that at a dose of 50 mg Moringa leaf ethanol extract can increase the pain response in the soles of the rats as a sign of improvement in neuropathic nerve cells, but not better than glibenclamide or glibenclamide + Vitamin B6. Group VII rats also experienced an increase in pain stimulus response with a better percentage when compared to group IV rats that were given glibenclamide alone. However, it was not better than group V rats given glibenclamide + Vitamin B6. The results of the hot plate test on group VIII rats showed better results than those on group IV and group V rats. That is, the group of rats treated with 150 mg extract was able to work better than glibenclamide but not better than glibenclamide + vitamin B6.

PEMBAHASAN

Oxidative stress is a biochemical trigger that leads to nerve dysfunction and reduced blood flow in diabetic rats, causing damage to nerve cells. In addition, nerves experience a reduction in glutathione and glutathione peroxidase activity. Neuropathy is a progressive process, where there is degeneration of nerve fibers causing symptoms such as pain or numbness. The nerves that are usually affected are those in the legs or arms. Neuropathy is caused by nerve structure damage and dysfunction due to increased polyol pathways, decreased myoinositol formation, and decreased Na/K ATPase, resulting in segmental demyelination or axonal atrophy.

The ethanol extract of Moringa Oleifera, which has antioxidant content, has been associated with an improvement in nerve function in hyperglycemic conditions. The extract contains flavonoids, tannins, anthraquinones, triterpenoids, saponins, and reduced sugars. Flavonoids in Moringa Oleifera can function as insulin secretagogues or insulin mimetics, minimizing diabetes complications. Moreover, the flavonoid compounds in Moringa Oleifera are beneficial for lowering blood sugar levels and have excellent antioxidant abilities, thus potentially restoring nerve function damaged by high blood sugar levels.

KESIMPULAN DAN SARAN

The results of the research that has been carried out on the ethanol extract of Moringa leaves, it can be concluded that the ethanolic extract of Moringa leaves with doses of 50, 100, and 150 has antihyperglycemic activity. There was a difference in the timing of neurotoxicity in normal and malnourished DM rats. In normal-feeding rats, the neurotoxicity period was 35 days, while in the nutritionally deficient group of rats, the neurotoxicity occurred on day 28 after STZ-Na induction. Moringa leaf ethanol extract at a dose of 50 mg did not provide better activity than glibenclamide or glibenclamide + Vitamin B6. Moringa leaf ethanol extract doses of 100 mg and 150 mg gave better activity than the Glibenclamide group, but not better than the glibenclamide + Vitamin B6 group. The most potent dose of Moringa leaf ethanol extract to exert a neuroprotective effect on STZ-Na-induced type 2 DM was at a dose of 150 mg.

DAFTAR PUSTAKA

Acute and Chronic Complications. (2017). *Diabetes*, *66*(Supplement_1), A101–A173. https://doi.org/10.2337/db17-381-663

Bjerg, L., Gudbjörnsdottir, S., Franzén, S., Carstensen, B., Witte, D. R., Jørgensen, M. E., & Svensson, A.-M. (2021). Duration of diabetes-related complications and mortality in type 1 diabetes: A national cohort study. *International Journal of Epidemiology*, *50*(4), 1250–1259. https://doi.org/10.1093/ije/dyaa290

Castelli, G., Desai, K. M., & Cantone, R. E. (2020). Peripheral Neuropathy: Evaluation and Differential Diagnosis. *American Family Physician*, *102*(12), 732–739.

Colvin, L. A., & Dougherty, P. M. (2015). Peripheral neuropathic pain: Signs, symptoms, mechanisms, and causes: are they linked? *BJA: British Journal of Anaesthesia*, *114*(3), 361–363. https://doi.org/10.1093/bja/aeu323

Haber, S. L., McMahon, R. P., Barajas, J., Hayes, A. R., & Hussein, H. (2020). Effects of Moringa oleifera in patients with type 2 diabetes. *American Journal of Health-System Pharmacy*, *77*(22), 1834–1837. https://doi.org/10.1093/ajhp/zxaa255

Harding, J. L., Pavkov, M. E., Magliano, D. J., Shaw, J. E., & Gregg, E. W. (2019). Global trends in diabetes complications: A review of current evidence. *Diabetologia*, *62*(1), 3–16. https://doi.org/10.1007/s00125-018-4711-2

Matschinsky, F. M., & Wilson, D. F. (2019). The Central Role of Glucokinase in Glucose Homeostasis: A Perspective 50 Years After Demonstrating the Presence of the Enzyme in Islets of Langerhans. *Frontiers in Physiology*, *10*. https://doi.org/10.3389/fphys.2019.00148

Santos Jr, A. R., Nascimento, V. A., Genari, S. C., Lombello, C. B., Jr, A. R. S., Nascimento, V. A., Genari, S. C., & Lombello, C. B. (2014). Mechanisms of Cell Regeneration—From Differentiation to Maintenance of Cell Phenotype. In *Cells and Biomaterials in Regenerative Medicine*. IntechOpen. https://doi.org/10.5772/59150

Vargas-Sánchez, K., Garay-Jaramillo, E., & González-Reyes, R. E. (2019). Effects of Moringa oleifera on Glycaemia and Insulin Levels: A Review of Animal and Human Studies. *Nutrients*, *11*(12), Article 12. https://doi.org/10.3390/nu11122907

Yapanis, M., James, S., Craig, M. E., O'Neal, D., & Ekinci, E. I. (2022). Complications of Diabetes and Metrics of Glycemic Management Derived From Continuous Glucose Monitoring. *The Journal of Clinical Endocrinology & Metabolism*, *107*(6), e2221–e2236. https://doi.org/10.1210/clinem/dgac034