©NIJPP
Publications 2026

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

NEWPORT INTERNATIONAL JOURNAL OF PUBLIC HEALTH AND PHARMACY (NIJPP)

Volume 7 Issue 1 Page 36-44, 2026

https://doi.org/10.59298/NIJPP/2026/713644

Nutritional Interventions in Diabesity: From Caloric Restriction to Precision Diets

Bwanbale Geoffrey David

Faculty of Pharmacy Kampala International University Uganda

ABSTRACT

Obesity with type 2 diabetes ("diabesity") arises when chronic caloric excess, low diet quality, and circadian misalignment overwhelm metabolic flexibility. Nutrition is therefore both cause and cure. Evidence across mechanistic studies and randomized trials shows that energy deficit can be achieved via continuous caloric restriction (CR), intermittent fasting (IF), or time-restricted eating (TRE), which improves glycemia, hepatic steatosis, and insulin sensitivity primarily by shrinking adipocyte size, reducing ectopic fat, and decompressing mitochondrial/ER stress. Beyond calories, macronutrient patterning matters: low-carbohydrate and Mediterranean-style diets often yield superior short-term glycemic control; high-quality low-fat patterns can be equally effective when adherence is high. Carbohydrate quality, like fiber, resistant starch, glycemic index/load, and food processing, modulates postprandial glucose and the gut–liver axis. Meal timing and circadian alignment shape insulin action and β-cell responsiveness independent of weight. Bioactive-rich foods and microbiome-directed strategies add complementary effects via short-chain fatty acids, bile-acid signaling, and inflammation control. The clinical frontier is precision nutrition: using continuous glucose monitoring (CGM), phenotyping (adiposity distribution, NAFLD, fasting/postprandial hyperglycemia), and, where validated, microbiome/metabolite readouts to tailor diet choice, meal timing, and macronutrient distribution to the individual. Implementation hinges on cultural fit, food environment, affordability, and digital behavior supports layered with pharmacotherapy (e.g., metformin, SGLT2 inhibitors, incretin-based agents). This review synthesizes mechanisms and comparative effectiveness from CR to precision diets, outlines practical protocols, and proposes a decision framework for matching people to sustainable nutrition that delivers durable glycemic control and cardiometabolic risk reduction.

Keywords: caloric restriction; time-restricted eating; low-carbohydrate diet; Mediterranean diet; precision nutrition

INTRODUCTION

Type 2 diabetes (T2D) most commonly coexists with excess adiposity. The resulting "diabesity" amplifies cardiovascular, renal, hepatic, and oncologic risk[1–3,4-8]. Pharmacotherapy is essential for many, yet durable risk reduction is rarely achieved without nutrition that lowers energy intake, improves diet quality, and aligns eating with circadian biology[4, 9-14]. Nutrition interventions influence glycemia through four dominant levers. First, energy deficit reduces adipocyte size and lipolysis, lowering non-esterified fatty-acid (NEFA) spillover to liver and muscle, thereby improving insulin signaling and decreasing hepatic glucose production[5, 15-20]. Second, macronutrient patterning alters glucose appearance and insulin demand: lower carbohydrate reduces postprandial excursions and can facilitate medication de-intensification; higher-protein increases satiety and thermogenesis; unsaturated fat improves lipid profiles[6,21-26]. Third, carbohydrate quality and processing (fiber amount/type, resistant starch, whole grains vs ultra-processed foods) reshape gut microbial metabolites, bile-acid pools, and GLP-1 secretion, improving insulin sensitivity and hepatic fat. Fourth, meal timing and circadian alignment (TRE, earlier distribution of calories) improve metabolic efficiency even without weight loss by enhancing insulin sensitivity and synchronizing hormonal rhythms[7, 27-30].

Heterogeneity demands individualized strategies. People differ in insulin secretion capacity, hepatic vs peripheral insulin resistance, adipose expandability, and β-cell reserve[8,31-37]. Glycemic phenotypes like fasting hyperglycemia (hepatic IR) vs postprandial hyperglycemia (limited first-phase insulin) respond differently to macronutrient distribution and timing. Co-morbidities shape priorities: NAFLD favors weight

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X
loss with carbohydrate moderation and high-quality fats; CKD limits protein and certain minerals; dyslipidemia guides fat choice and carbohydrate quality; gastrointestinal conditions influence fiber type and meal frequency. Socio-cultural context (budget, time, food traditions) and food environment (availability, marketing) govern feasibility; sustainability considerations (plant-forward choices, food waste) influence long-term adoption[8,38-43].

Comparative-effectiveness trials show multiple diets can succeed when they produce a sustained energy deficit and high adherence. Thus, "best diet" is the plan a given person can maintain that achieves (i) ≥5–10% weight loss if needed, (ii) HbA1c reduction and time-in-range improvement, (iii) cardiometabolic risk improvement (BP, LDL-C/apoB, TG/HDL, NAFLD), and (iv) quality-of-life gains. Tools that raise adherence, structured meal plans, culinary skills coaching, food provisioning, CGM feedback, and medication alignment often determine outcomes more than macronutrient debates[9,44-49]. Nevertheless, physiology-informed choices can speed benefit and reduce therapeutic inertia.

This review proceeds from caloric restriction paradigms to precision diets, integrating mechanisms with practical protocols. Section 1 compares continuous CR, IF, and TRE, detailing energy balance, appetite hormones, and safety. Section 2 contrasts macronutrient strategies (low-carb/ketogenic, high-protein, low-fat, Mediterranean) with evidence on glycemia, lipids, and adherence.

2. Caloric Restriction Paradigms: Continuous CR, Intermittent Fasting, and Time-Restricted Eating

Energy deficit is the common pathway for weight loss and glycemic improvement. Continuous caloric restriction (CR) reduces daily intake by ~20–35% below maintenance, delivered via portion control, calorie-aware meal plans, or energy-density approaches (high-volume, low-calorie foods)[10,50-57]. Mechanisms include decreased adipocyte size, lower NEFA flux, reduced hepatic de novo lipogenesis, and improved insulin signaling through diminished ectopic fat. Appetite hormones adapt: leptin falls, ghrelin rises; satiety peptides (GLP-1, PYY) may decline without weight-maintenance strategies, making structured support critical to sustain loss[10,58-64].

Intermittent fasting (IF) alternates restricted and unrestricted days. Common forms are ***5:2*** (two non-consecutive days at ~500–700 kcal) and alternate-day fasting (ADF). IF can match continuous CR for weight loss with similar or slightly greater early glycemic improvements, possibly via pronounced negative energy balance on fast days and increased insulin sensitivity after short fasts[11, 65-70]. However, individual tolerance varies, and overeating on non-fast days can erode benefits. Medication adjustment is essential to avoid hypoglycemia (especially with insulin/sulfonylureas).

Time-restricted eating (TRE) confines intake to a daily 6–10-hour window, often favoring earlier windows (e.g., 8 a.m.–4 p.m.)[12,71-78]. TRE leverages circadian biology: insulin sensitivity and β-cell responsiveness peak earlier in the day, while evening eating worsens glycemia. TRE improves fasting glucose, HOMA-IR, and blood pressure independent of large weight loss, and typically enhances sleep timing and dietary structure. Practical protocols pair TRE with balanced macronutrients, adequate protein (≥1.0–1.2 g/kg/day in weight loss to preserve lean mass), and hydrating, fiber-rich foods to curb hunger[12,79-84].

Safety and selection. CR/IF/TRE require tailoring for older adults at sarcopenia risk (prioritize resistance training and protein), pregnancy/lactation (generally avoid fasting), eating-disorder history (avoid IF), advanced CKD, and those with intensive insulin regimens[13]. For many with T2D, combining caloric strategies with incretin-based pharmacotherapy (GLP-1 RAs, GLP-1/GIP co-agonists) improves satiety, protects lean mass, and simplifies adherence. Behavioral supports goal setting, high-protein breakfasts, planned snacks during early adaptation, and CGM-informed feedback boost success and mitigate compensatory appetite[13, 85-90].

3. Macronutrient Strategies: Low-Carbohydrate, Ketogenic, Low-Fat, High-Protein, and Mediterranean Patterns

Low-carbohydrate diets (LCDs) (generally <130 g/day) reduce postprandial glucose and insulin exposure, enabling early medication de-intensification and improved glycemic variability[14,91-94]. Ketogenic variants (<50 g/day) increase ketone bodies, suppress appetite, and rapidly decrease hepatic fat; longer-term LDL-C/apoB effects depend on fat sources (favor unsaturated fats) and individual hyper-responders. Adequate minerals, fiber (non-starchy vegetables, seeds), and repletion of sodium/potassium/magnesium help manage "keto-flu." LCDs fit best for postprandial hyperglycemia, high triglycerides, NAFLD, and those preferring savory foods; careful lipid monitoring is advised[14,95-97].

Low-fat diets (LFDs) emphasize <25–30% energy from fat with grains/legumes/fruit/vegetables as staples. When energy deficit and fiber density are high, LFDs reduce LDL-C and improve insulin sensitivity[15]. Ultra-processed LFDs perform poorly; whole-food LFDs rich in legumes and intact grains can match LCDs for weight loss at similar adherence. High-protein diets (≥25–30% energy, ~1.2–1.6 g/kg/day) enhance satiety and thermogenesis, preserve lean mass in weight loss, and reduce late-night snacking; protein distribution (25–35 g/meal) supports muscle protein synthesis. In CKD, protein targets require nephrology guidance.

Mediterranean-style diets prioritize extra-virgin olive oil, nuts, legumes, whole grains, vegetables, fruit, and seafood, with limited red/processed meat. Benefits span glycemia, NAFLD, and cardiovascular outcomes via improved lipid profiles, polyphenol-mediated endothelial effects, and anti-inflammatory mechanisms.

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X
Carbohydrate quality and fat type (mono-/omega-3 PUFA) drive much of the advantage; energy intake still matters[16].
Comparative effectiveness and adherence. Across RCTs, diet arms often converge at ~5–7% weight loss when support intensity matches. Differences in HbA1c and lipids reflect adherence, baseline phenotype, and medication changes. LCDs excel in short-term glycemic lowering and TG reduction; LFDs often lead in LDL-C lowering; Mediterranean patterns balance glycemia with cardioprotection[17]. Hybrid approaches e.g., lower-carb Mediterranean or plant-predominant LCDs—capture strengths of both. Diet choice should reflect glycemic phenotype (fasting vs postprandial), lipid priorities (LDL-C/apoB vs TG/HDL), personal food culture, and sustainability preferences[17].

Implementation tips. Front-load protein/fiber at meals; anchor a high-protein breakfast; build meals around a protein + high-fiber vegetable + smart carb or unsaturated fat; minimize refined flour/sugary beverages; swap ultra-processed snacks for nuts/legumes/fruit; cook with EVOO; and plan batch-cooked staples. Align medication down-titration with improved CGM metrics to avoid hypoglycemia[18].

4. Carbohydrate Quality and Processing: Fiber, Resistant Starch, GI/GL, and Ultra-Processed Foods

Carbohydrate quality strongly influences postprandial glycemia and long-term insulin sensitivity. Dietary fiber, particularly viscous (β-glucan, psyllium) and fermentable types (inulin, resistant starch), slows glucose absorption, increases satiety, and feeds gut microbes that generate short-chain fatty acids (SCFAs)[19]. Resistant starch (RS) (types 2–4; e.g., cooled potatoes/rice, legumes, green bananas, high-amylose maize) increases colonic butyrate, improves insulin sensitivity in some phenotypes, and reduces glycemic variability. Aim for ≥30–40 g/day total fiber with a mix of soluble/insoluble and RS sources[20].
Glycemic index (GI)/load (GL) capture the glucose-raising potential of foods/meals, but real-world responses vary by food matrix, cooking method, and microbiome. Low-GI patterns reduce HbA1c modestly, especially when replacing refined starches with intact grains/legumes and pairing with protein/fat[21]. Food processing level is decisive: ultra-processed foods (UPFs) tend to be low in fiber, high in rapidly digestible starch/sugars, emulsifiers, and sodium; they promote passive overconsumption, reduce satiety signals, and may impair barrier function and gut microbial ecology, amplifying metabolic endotoxemia and insulin resistance[21].
Practical swaps. Replace refined grains with intact kernels (oats, barley, brown/red rice), rye or whole-wheat sourdoughs, and legumes as "smart carbs". Use mixed-meal sequencing (vegetables/protein before starch) to blunt glycemic spikes; add vinegar or lemon (acetic acid) to meals to lower postprandial glucose. Choose fruit over juice; prefer chewing over drinking calories. For snacks, prioritize nuts, seeds, edamame, or yogurt over chips/sweets. Optimize protein leverage by providing 25–35 g protein at main meals to reduce drive for energy from low-protein UPFs[22].
Micronutrients and bioactives. Magnesium, potassium, and polyphenol-rich foods (berries, cocoa, tea, herbs/spices) improve endothelial and insulin signaling; combine with fiber to enhance microbial biotransformation into beneficial phenolics. Ensure adequate vitamin D and B-vitamins for metabolic and one-carbon pathways relevant to epigenetic regulation. Together, high-quality carbohydrate patterns reduce glycemic volatility, improve satiety, and favorably remodel the gut–liver axis[23].

5. Meal Timing, Distribution, and Circadian Alignment

Metabolism follows a circadian rhythm: insulin sensitivity, β-cell responsiveness, and diet-induced thermogenesis peak earlier in the day, while evening eating increases glycemic excursions and lipogenesis[24]. Early time-restricted eating (eTRE), condensing intake into an 8–10-hour window ending mid-afternoon, improves fasting glucose, HOMA-IR, BP, and appetite even without large weight changes. Front-loading calories (larger breakfast/lunch, lighter dinner) enhances 24-h glycemia and satiety. Conversely, late eating and irregular meal timing undermine glycemic control and sleep quality[24].
Macronutrient distribution by time of day can exploit physiology: prioritize protein and complex carbs earlier (supporting training and work), shift starch lower at dinner, and anchor evenings with vegetables, lean protein, and healthy fats[25]. Pre-meal strategies (fiber/vegetable starters, protein shakes, or a small nut serving) attenuate postprandial spikes. Meal frequency should fit hunger patterns and medications; for most with T2D, 2–3 structured meals plus optional planned snack(s) outperform grazing[25].
Short sleep and circadian misalignment increase hunger and insulin resistance. Pair TRE with sleep regularity (consistent bed/wake times) to synchronize central and peripheral clocks. For shift workers, aim for a fixed fasting block aligned to the longest sleep episode; avoid eating in the biological night; use higher-protein, lower-GI foods during night shifts when eating is unavoidable[26].
Light-to-moderate activity (10–20 min walking) after meals blunts glucose peaks; resistance training in the late afternoon/early evening can improve next-day fasting glucose. Align carbohydrate intake to exercise ("fuel for the work required") to optimize performance and mitochondrial adaptations while preserving glycemic stability[27].
As timing strategies lower glucose variability, hypoglycemia risk with insulin or sulfonylureas rises unless doses are reduced; CGM and clinician partnership are essential during transitions. Overall, aligning what and when

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

we eat strengthens metabolic control beyond calories alone and improves adherence by creating predictable routines[28].

6. Bioactive-Rich Foods, Microbiome-Directed Nutrition, and Postbiotics

Dietary bioactives and the gut microbiome provide a complementary lever for glycemic control. Prebiotic fibers (inulin, FOS/GOS, arabinoxylan, β-glucan) and resistant starches expand SCFA-producing guilds, increasing butyrate/propionate that support barrier integrity, GLP-1/PYY secretion, and hepatic/muscle insulin sensitivity. Fermented foods (yogurt, kefir, kimchi, tempeh) introduce live microbes and metabolites that can lower inflammation and improve glycemia modestly[29].

Polyphenol-rich foods like berries, cocoa, tea/coffee, extra-virgin olive oil, herbs/spices—are metabolized by microbes into bioactive phenolics (e.g., urolithins) that modulate endothelial function, mitophagy, and inflammatory signaling[30, 31]. Nuts and seeds provide unsaturated fats, fiber, minerals, and polyphenols; regular intake improves TG/HDL and glycemic variability. Omega-3 (marine or algal) supports triglyceride lowering and may aid hepatic fat reduction[30].

Targeted probiotics (selected *Bifidobacterium/Lactobacillus* strains) and synbiotics yield small improvements in HOMA-IR and inflammatory markers, with strain-specific effects; pasteurized *Akkermansia muciniphila* and next-gen consortia are promising but currently adjunctive. Postbiotics such as SCFA donors (e.g., tributyrin) or designed fibers (propionate inulin ester) directly deliver beneficial metabolites, though GI tolerance limits dosing[32–35].

Practical toolkit. Build plates with a fiber-first mindset: two vegetable portions per meal, a legume or intact grain most days, nuts/berries for snacks, and fermented foods several times weekly. Replace refined flour with whole-grain sourdoughs/rye; add RS via cooled/reheated starches. Choose EVOO and avocado/olive/nut toppings over oils high in omega-6 seed oils when possible. These shifts are compatible with LCD, LFD, and Mediterranean plans and often enhance satiety and adherence.

Safety and equity. Emphasize affordable, locally available fiber staples (beans, lentils, seasonal produce), culturally familiar fermented foods, and home cooking skills. Screen for GI disorders when escalating fiber; titrate slowly with hydration. Microbiome tests are evolving; prioritize proven dietary patterns while research refines personalized microbe-based prescriptions[36].

7 Precision Nutrition: Phenotyping, CGM-Guided Personalization, and Real-World Implementation

Precision diets tailor what and when to eat to an individual's biology and context. Start with clinical phenotyping: adiposity pattern (visceral vs subcutaneous), NAFLD status, lipid profile (TG-rich vs LDL-driven), blood pressure, kidney function, physical activity, and glycemic patterning (CGM)[37]. People with pronounced postprandial hyperglycemia often benefit from lower-carb breakfast/lunch, protein-anchored meals, pre-meal fiber, and post-meal walking; those with fasting hyperglycemia (hepatic IR) respond to weight loss, evening carbohydrate reduction, earlier TRE, and improved sleep[38].

Algorithmic personalization integrates baseline features to select initial diet: LCD for NAFLD/high TG/postprandial spikes; Mediterranean for ASCVD risk/LDL focus; high-fiber low-GI for hunger control and gut health; eTRE/TRE for circadian disruption. Layer bioactive emphasis based on needs (e.g., RS and β-glucan for glycemia and LDL-C; nuts/EVOO for TG/HDL; fermented foods for GI symptoms). Reassess at 4–8 weeks; maintain, switch, or hybridize based on HbA1c/CGM, weight, lipids, and adherence.

Medication synergy. Nutrition and anti-diabetic drugs work best together. GLP-1 RAs and co-agonists boost satiety and allow deeper energy deficits; SGLT2 inhibition reduces glucotoxicity and supports fasting glucose; metformin improves hepatic IR and may augment microbiome benefits. Align dose reductions with CGM trends to prevent hypoglycemia; ensure protein and resistance training to protect lean mass during rapid weight loss.

Implementation science. Success depends on access and support: budget-aligned meal plans, shopping lists, batch-cook templates; culturally adapted recipes; workplace/school strategies; and digital nudges (SMS prompts, app-based trackers). Group visits, culinary medicine classes, and food-as-medicine programs (produce prescriptions) improve adoption. Environmental levers like healthy defaults, smaller plates, and visible fruits/vegetables reduce friction.

Equity and sustainability. Favor plant-forward, minimally processed staples that are affordable and culturally acceptable. Consider local food systems and seasonality. Sustainable diets lower long-term health and environmental costs, supporting policy advocacy (taxes on sugary drinks, front-of-pack labeling, school meals).

CONCLUSION

In practice, precision nutrition is iterative: start with a plausible plan matched to phenotype and preferences, measure response, and refine. When embedded in comprehensive care, nutrition can drive remission or major improvement of diabesity for many people.

REFERENCES

1. AbdlWhab, H.M., Al-Saffar, A., Mahdi, O.A., Alameri, R.B.: The impact of insulin resistance and glycaemic control on insulin-like growth factor-1 in patients with type 2 diabetes: a cross-sectional study. Clin. Diabetes Endocrinol. 10, 36 (2024). https://doi.org/10.1186/s40842-024-00202-8

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

2. Apostolopoulou, M., Lambadiari, V., Roden, M., Dimitriadis, G.D.: Insulin Resistance in Type 1 Diabetes: Pathophysiological, Clinical, and Therapeutic Relevance. Endocr. Rev. 46, 317–348 (2025). https://doi.org/10.1210/endrev/bnae032
3. Alum, E.U., Obasi, D.C., Abba, J.N., Aniokete, U.C., Okoroh, P.N., Akwari, A.Ak.: Evolving Paradigms in Nutrition Therapy for Diabetes: From Carbohydrate Counting to Precision Diets. Obes. Med. 100622 (2025). https://doi.org/10.1016/j.obmed.2025.100622
4. Chang, Y., Du, T., Zhuang, X., Ma, G.: Time-restricted eating improves health because of energy deficit and circadian rhythm: A systematic review and meta-analysis. iScience. 27, 109000 (2024). https://doi.org/10.1016/j.isci.2024.109000
5. Najjar, S.M., Abdolahipour, R., Ghadieh, H.E., Jahromi, M.S., Najjar, J.A., Abuamreh, B.A.M., Zaidi, S., Kumarasamy, S., Muturi, H.T.: Regulation of Insulin Clearance by Non-Esterified Fatty Acids. Biomedicines. 10, 1899 (2022). https://doi.org/10.3390/biomedicines10081899
6. Samkani, A., Skytte, M.J., Kandel, D., Kjaer, S., Astrup, A., Deacon, C.F., Holst, J.J., Madsbad, S., Rehfeld, J.F., Haugaard, S.B., Krarup, T.: A carbohydrate-reduced high-protein diet acutely decreases postprandial and diurnal glucose excursions in type 2 diabetes patients. Br. J. Nutr. 119, 910–917 (2018). https://doi.org/10.1017/S0007114518000521
7. Bindels, L.B., Segura Munoz, R.R., Gomes-Neto, J.C., Mutemberezi, V., Martínez, I., Salazar, N., Cody, E.A., Quintero-Villegas, M.I., Kittana, H., de los Reyes-Gavilán, C.G., Schmaltz, R.J., Muccioli, G.G., Walter, J., Ramer-Tait, A.E.: Resistant starch can improve insulin sensitivity independently of the gut microbiota. Microbiome. 5, 12 (2017). https://doi.org/10.1186/s40168-017-0230-5
8. Cefalu, W.T., Andersen, D.K., Arreaza-Rubín, G., Pin, C.L., Sato, S., Verchere, C.B., Woo, M., Rosenblum, N.D.: Heterogeneity of Diabetes: β-Cells, Phenotypes, and Precision Medicine: Proceedings of an International Symposium of the Canadian Institutes of Health Research's Institute of Nutrition, Metabolism and Diabetes and the U.S. National Institutes of Health's National Institute of Diabetes and Digestive and Kidney Diseases. Diabetes Care. 45, 3–22 (2022). https://doi.org/10.2337/dci21-0051
9. Dyńka, D., Rodzeń, Ł., Rodzeń, M., Pacholak-Klimas, A., Ede, G., Sethi, S., Łojko, D., Bartoń, K., Berry, K., Deptuła, A., Grzywacz, Ż., Martin, P., Unwin, J., Unwin, D.: Ketogenic Diets for Body Weight Loss: A Comparison with Other Diets. Nutrients. 17, 965 (2025). https://doi.org/10.3390/nu17060965
10. Kim, J.Y.: Optimal Diet Strategies for Weight Loss and Weight Loss Maintenance. J. Obes. Metab. Syndr. 30, 20–31 (2021). https://doi.org/10.7570/jomes20065
11. Elortegui Pascual, P., Rolands, M.R., Eldridge, A.L., Kassis, A., Mainardi, F., Lê, K., Karagounis, L.G., Gut, P., Varady, K.A.: A meta-analysis comparing the effectiveness of alternate day fasting, the 5:2 diet, and time-restricted eating for weight loss. Obes. Silver Spring Md. 31, 9–21 (2023). https://doi.org/10.1002/oby.23568
12. Regmi, P., Heilbronn, L.K.: Time-Restricted Eating: Benefits, Mechanisms, and Challenges in Translation. iScience. 23, 101161 (2020). https://doi.org/10.1016/j.isci.2020.101161
13. Argyropoulou, D., Geladas, N.D., Nomikos, T., Paschalis, V.: Exercise and Nutrition Strategies for Combating Sarcopenia and Type 2 Diabetes Mellitus in Older Adults. J. Funct. Morphol. Kinesiol. 7, 48 (2022). https://doi.org/10.3390/jfmk7020048
14. Mongkolsucharitkul, P., Surawit, A., Pimsen, A., Winitchayothin, S., Pumeiam, S., Pinsawas, B., Ophakas, S., Suta, S., Pasookhush, P., Mayurasakorn, K.: Effectiveness of low-carbohydrate diets on type 2 diabetes: A systematic review and *meta*-analysis of randomized controlled trials in Eastern vs. Western populations. Diabetes Res. Clin. Pract. 229, 112464 (2025). https://doi.org/10.1016/j.diabres.2025.112464
15. Kahleova, H., Petersen, K.F., Shulman, G.I., Alwarith, J., Rembert, E., Tura, A., Hill, M., Holubkov, R., Barnard, N.D.: Effect of a Low-Fat Vegan Diet on Body Weight, Insulin Sensitivity, Postprandial Metabolism, and Intramyocellular and Hepatocellular Lipid Levels in Overweight Adults. JAMA Netw. Open. 3, e2025454 (2020). https://doi.org/10.1001/jamanetworkopen.2020.25454
16. Rahideh, S.T., Shidfar, F.: The Mediterranean diet and nonalcoholic fatty liver disease in individuals at high cardiovascular risk. Hepatobiliary Surg. Nutr. 9, 654–656 (2020). https://doi.org/10.21037/hbsn.2019.12.09
17. Shinde, S., Thieu, V.T., Kwan, A.Y.M., Houghton, K., Meyers, J., Schapiro, D.: Impact of Weight Change on Glycemic Control and Metabolic Parameters in T2D: A Retrospective US Study Based on Real-World Data. Diabetes Ther. 15, 409–426 (2024). https://doi.org/10.1007/s13300-023-01511-4
18. Amankwaah, A.F., Sayer, R.D., Wright, A.J., Chen, N., McCrory, M.A., Campbell, W.W.: Effects of Higher Dietary Protein and Fiber Intakes at Breakfast on Postprandial Glucose, Insulin, and 24-h Interstitial Glucose in Overweight Adults. Nutrients. 9, 352 (2017). https://doi.org/10.3390/nu9040352
19. Giuntini, E.B., Sardá, F.A.H., de Menezes, E.W.: The Effects of Soluble Dietary Fibers on Glycemic Response: An Overview and Futures Perspectives. Foods. 11, 3934 (2022). https://doi.org/10.3390/foods11233934

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

20. Wang, Z., Wang, S., Xu, Q., Kong, Q., Li, F., Lu, L., Xu, Y., Wei, Y.: Synthesis and Functions of Resistant Starch. Adv. Nutr. 14, 1131–1144 (2023). https://doi.org/10.1016/j.advnut.2023.06.001
21. Vlachos, D., Malisova, S., Lindberg, F.A., Karaniki, G.: Glycemic Index (GI) or Glycemic Load (GL) and Dietary Interventions for Optimizing Postprandial Hyperglycemia in Patients with T2 Diabetes: A Review. Nutrients. 12, 1561 (2020). https://doi.org/10.3390/nu12061561
22. Ortinau, L.C., Hoertel, H.A., Douglas, S.M., Leidy, H.J.: Effects of high-protein vs. high- fat snacks on appetite control, satiety, and eating initiation in healthy women. Nutr. J. 13, 97 (2014). https://doi.org/10.1186/1475-2891-13-97
23. Keflie, T.S., Biesalski, H.K.: Micronutrients and bioactive substances: Their potential roles in combating COVID-19. Nutr. Burbank Los Angel. Cty. Calif. 84, 111103 (2021). https://doi.org/10.1016/j.nut.2020.111103
24. Steger, F.L., Jamshed, H., Bryan, D.R., Richman, J.S., Warriner, A.H., Hanick, C.J., Martin, C.K., Salvy, S.-J., Peterson, C.M.: Early Time-Restricted Eating Affects Weight, Metabolic Health, Mood, and Sleep in Adherent Completers: A Secondary Analysis. Obes. Silver Spring Md. 31, 96–107 (2023). https://doi.org/10.1002/oby.23614
25. Espinosa-Salas, S., Gonzalez-Arias, M.: Nutrition: Macronutrient Intake, Imbalances, and Interventions. In: StatPearls. StatPearls Publishing, Treasure Island (FL) (2025)
26. Eckel, R.H., Depner, C.M., Perreault, L., Markwald, R.R., Smith, M.R., McHill, A.W., Higgins, J., Melanson, E.L., Wright, K.P.: Morning Circadian Misalignment during Short Sleep Duration Impacts Insulin Sensitivity. Curr. Biol. CB. 25, 3004–3010 (2015). https://doi.org/10.1016/j.cub.2015.10.011
27. Smith, J.A.B., Murach, K.A., Dyar, K.A., Zierath, J.R.: Exercise metabolism and adaptation in skeletal muscle. Nat. Rev. Mol. Cell Biol. 24, 607–632 (2023). https://doi.org/10.1038/s41580-023-00606-x
28. Kovatchev, B., Cobelli, C.: Glucose Variability: Timing, Risk Analysis, and Relationship to Hypoglycemia in Diabetes. Diabetes Care. 39, 502–510 (2016). https://doi.org/10.2337/dc15-2035
29. Nie, Q., Hu, J., Gao, H., Li, M., Sun, Y., Chen, H., Zuo, S., Fang, Q., Huang, X., Yin, J., Nie, S.: Bioactive Dietary Fibers Selectively Promote Gut Microbiota to Exert Antidiabetic Effects. J. Agric. Food Chem. 69, 7000–7015 (2021). https://doi.org/10.1021/acs.jafc.1c01465
30. García-Conesa, M.-T., Larrosa, M.: Polyphenol-Rich Foods for Human Health and Disease. Nutrients. 12, 400 (2020). https://doi.org/10.3390/nu12020400
31. Umoru, G.U., Atangwho, I.J., David-Oku, E., Uti, D.E., De Campos, O.C., Udeozor, P.A., Nfona, S.O., Lawal, B., Alum, E.U.: Modulation of Lipogenesis by Tetracarpidium conophorum Nuts via SREBP-1/ACCA-1/FASN Inhibition in Monosodium-Glutamate-Induced Obesity in Rats. Nat. Prod. Commun. 20, 1934578X251344035 (2025). https://doi.org/10.1177/1934578X251344035
32. Abdul Manan, M.: The role of probiotics in personalized therapeutics: Advances in gut microbe-driven interventions. The Microbe. 8, 100497 (2025). https://doi.org/10.1016/j.microb.2025.100497
33. Anchidin-Norocel, L., Iatcu, O.C., Lobiuc, A., Covasa, M.: Heavy Metal–Gut Microbiota Interactions: Probiotics Modulation and Biosensors Detection. Biosensors. 15, 188 (2025). https://doi.org/10.3390/bios15030188
34. D'Amico, V., Cavaliere, M., Ivone, M., Lacassia, C., Celano, G., Vacca, M., la Forgia, F.M., Fontana, S., De Angelis, M., Denora, N., Lopedota, A.A.: Microencapsulation of Probiotics for Enhanced Stability and Health Benefits in Dairy Functional Foods: A Focus on Pasta Filata Cheese. Pharmaceutics. 17, 185 (2025). https://doi.org/10.3390/pharmaceutics17020185
35. Ji, J., Jin, W., Liu, S., Jiao, Z., Li, X.: Probiotics, prebiotics, and postbiotics in health and disease. MedComm. 4, e420 (2023). https://doi.org/10.1002/mco2.420
36. Gill, S.K., Rossi, M., Bajka, B., Whelan, K.: Dietary fibre in gastrointestinal health and disease. Nat. Rev. Gastroenterol. Hepatol. 18, 101–116 (2021). https://doi.org/10.1038/s41575-020-00375-4
37. Alum, E.U.: Optimizing patient education for sustainable self-management in type 2 diabetes. Discov. Public Health. 22, 44 (2025). https://doi.org/10.1186/s12982-025-00445-5
38. Baldelli, S., Aiello, G., Mansilla Di Martino, E., Campaci, D., Muthanna, F.M.S., Lombardo, M.: The Role of Adipose Tissue and Nutrition in the Regulation of Adiponectin. Nutrients. 16, 2436 (2024). https://doi.org/10.3390/nu16152436
39. Obeagu EI, Alum EU, Obeagu GU, Ugwu OP. Prostate Cancer: Review on Risk Factors. Eurasian Experiment Journal of Public Health(EEJPH). 2023;4(1):4-7.
40. Ugwu OP, Amasiorah VI. The effects of crude ethanol root extract and fractions of sphenocentrum jollyanum on the lipid profile of streptozotocininduced diabetic wistar albino rats. IDOSR Journal of Biology, Chemistry And Pharmacy. 2020;5(1):36-46.
41. Igwenyi IO, Nchi PO, Okechukwu UP, Igwenyi IP, Obasi DC, Edwin N, Uraku AJ, Ze AC. Nutritional potential of Azadirachta indica seeds. Indo American Journal of Pharmaceutical Sciences. 2017 Feb 1;4(2):477-82.

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

42. Offor CE, Okaka AN, Ogbugo SO, Egwu CO, Ugwu PC. Effects of ethanol leaf extract of Pterocarpus santalinoides on haemoglobin, packed cell volume and platelets. IOSR-JNHS 2015; 4: 108. 2015;112:93.
43. Obeagu EI, Alum EU, Ugwu OPC. Hepcidin: The gatekeeper of iron in malaria resistance. Newport Int J Res Med Sci. 2023;4(2):1–8. doi:10.59298/NIJRMS/2023/10.1.1400.
44. Offor CE, Agidi JU, Egwu CO, Ezeani N, Okechukwu PCU. Vitamin and mineral contents of Gongronema latifolium leaves. World J Med Sci. 2015;12(2):189–91.
46. Ogbanshi ME, Agbafor KN, Ominyi CM, Okechukwu PCU, Nwali BU, Ali FU. Changes in reproductive functions of adult male rats administered water and salt samples from Okposi and Uburu Nigerian salt lakes. Am Eurasian J Toxicol Sci. 2015;7(2):55–62.
47. Okechukwu PCU, Offor CE, Ibiam UA, Ezugwu AL, Uraku AJ, Igwe CN, Okon MB. The effect of ethanol extract of Jatropha curcas on renal markers of chloroform intoxicated albino Wistar rats. Eur J Biol Sci. 2015;7(1):21–5. doi:10.5829/idosi.ejbs.2015.7.01.1106.
48. Offor CE, Aja PC, Ugwu O, Agbafo KN. The effects of ethanol leaf-extract of Gmelina arborea on total protein and albumin concentrations in albino rats. Glob. J. Environ. Res. 2015;9(1):1-4.
49. Alum E, Ugwu PC, Egba S, Uti D, Alum B. Extension, KP: Climate Variability and Malaria Transmission: Unraveling the Complex Relationship. INOSR Scientific Research. 11, 16–22 (2024) [Internet]. 2013
50. Onyeze RC, Udeh SM, Okwor JC, Ugwu OP. Isolation and characterization of bacteria that are associated with the production and spoilage of ogi (akamu). International Journal of Pharma Medcine and Biological Sciences. 2013;2(3):79-85.
51. Alum EU, Obeagu EI, Ugwu OP-C. Enhancing quality water, good sanitation, and proper hygiene is the panacea to diarrhea control and the attainment of some related sustainable development goals: A review. Medicine (Baltimore). 2024 Sep 20;103(38):e39578. doi:10.1097/MD.0000000000039578.
52. Alum EU, Uti DE, Obeagu EI, Ugwu OPC, Alum BN. Cancer's psychosocial aspects: impact on patient outcomes. Elite J Med. 2024;2(6):32–42.
53. Alum EU, Ugwu OP. Nutritional Strategies for Rheumatoid Arthritis: Exploring Pathways to Better Management. INOSR Scientific Research. 2023;10(1):18-26.
54. Alum EU, Mathias CD, Ugwu OP, Aja PM, Obeagu EI, Uti DE, Okon MB. Phytochemical composition of Datura stramonium ethanol leaf and seed extracts: A comparative study. IAA Journal of Biological Sciences. 2023;10(1):118-25.
55. Ugwu Okechukwu PC, Amasiorah VI. Review on Health Implications. Benefits and Biochemistry of Alcohol Intoxication, INOSR Experimental Sciences. 2020;6(1):62-74.
56. PC UO, Amasiorah VI. Review on Health Implications, Benefits and Biochemistry of Alcohol Intoxication. INOSR Experimental Sciences. 2020;6(1):62-74.
57. Okechukwu P, Ossai D, Tukur G, Eze O, Ekwueme OC. Bacteriuria and urinary schistosomiasis in primary school children in rural communities in Enugu State, Nigeria. Pan African Medical Journal. 2014;18:15.
58. Odo Christian E, Nwodo Okwesili FC, Joshua Parker E, Ugwu Okechukwu PC, Okonkwo CC. Acute Toxicity Investigation And Anti-Diarrhoeal Effect Of The Chloroform-Methanol Extract Of Seed Of Persea Americana. Journal of Pharmacy Research. 2013;6(2):331-5.
59. Alum EU, Uti DE, Ugwu OPC, Obeagu EI, Alum BN. Unveiling the microbial orchestra: exploring the role of microbiota in cancer development and treatment. Discov Onc. 2025;16:646. doi:10.1007/s12672-025-02352-2.
60. Alum EU, Ugwu OPC, Egba SI, Uti DE, Alum BN. Climate variability and malaria transmission: unraveling the complex relationship. INOSR Sci Res. 2024;11(2):16–22. doi:10.59298/INOSRSR/2024/1.1.21622.
61. Ugwu CN, Okon MB, Ugwu OP. The Effects of Freezing on the Nutritional Composition of Fish. INOSR Experimental Sciences. 2024;13(1):61-5.
62. Alum EU, Ugwu OP, Obeagu EI, Orji OU, Edwin N, Okon MB. Religious Leaders as Advocates for Promoting Exclusive Breastfeeding in East Africa. International Journal of Innovative and Applied Research. 2023;11(12):10-5.
63. Obeagu EI, Obeagu GU, Alum EU, Ugwu OP. Comprehensive Review of Antiretroviral Therapy Effects on Red Blood Cells in HIV Patients. INOSR Experimental Sciences. 2023;12(3):63-72.
64. Onyeze RC, Onah GT, Onwukwe CL, Ugwu OPC. Comparative effects of neem and lemongrass leaf extracts on Salmonella spp. World J Pharm Res. 2013;2(4):1177–1185.
65. Obeagu EI, Obeagu GU, Alum EU, Ugwu OP. Understanding the Impact of HIV-Associated Bone Marrow Alterations on Erythropoiesis. INOSR Scientific Research. 2023;10(1):1-1.
66. Ugwu Okechukwu PC, Amasiorah VI. The In vitro Antioxidant Potentials of the Crude Ethanol Root Extract and Fractions of Sphenocentrum jollyanum. INOSR Applied Sciences 6 (1). 2020:125-33.
67. Ugwu Okechukwu PC, Onyeneke EC, Igwenyi IO, Aja PM, Ugwuoke KC, Okon Michael B, Onyeke SC. The Effects of Crude Ethanol Root Extract and Fractions of Sphenocentrum jollyanum on Liver and Kidney Function Parameters of StreptozotocinInduced Diabetic Wistar

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

68 Aja PM, Udeh SM, Opajobi AO, Uzuegbu UE, Alum EU, Edwin N, Okechukwu UP. HEPATO-PROTECTIVE EFFECT OF AQUEOUS LEAF-EXTRACT OF TALINUM TRIANGULARE IN MONOSODIUM GLUTAMATE (MSG) INDUCED HEPATIC DAMAGE IN ALBINO RATS. Indo American Journal of Pharmaceutical Sciences. 2017 Feb 1;4(2):464-70.Albino Rats. IAA Journal of Scientific Research. 2018;4(1):75-90.

69. Offor C, Chukwu B, Igwenyi I, Ugwu OP, Aja P. Effect of Ethanol Leaf-Extract of Annona muricata on Serum Total Protein and Albumin Concentrations in Albino Rats. Academic Journal of Oral and Dental Medicine. 2015;2(1):5-7.

70. Chukwuezi Fabian O, Ugwu Okechukwu PC. Distribution of Mycobacterium bacilli in Onitsha Metropolis and its Relationship with HIV Infection. Pharmanest An International Journal of Advances in Pharmaceutical Sciences. 2013;4(5):902-6.

71. Uti DE, Alum EU, Atangwho IJ, Obeagu EI, Ugwu OPC. Lipid-based nano-carriers for the delivery of anti-obesity natural compounds: advances in targeted delivery and precision therapeutics. J Nanobiotechnol. 2025;23:336. doi:10.1186/s12951-025-03412-z.

72. Alum EU, Ugwu OPC. Artificial intelligence in personalized medicine: transforming diagnosis and treatment. Discov Appl Sci. 2025;7:193. doi:10.1007/s42452-025-06625-x.

73. Onyeze RC, Udeh SMC, Ani LC, Ugwu OPC. Microbiology of honey collected from three different locations in Enugu State, Nigeria. World J Pharm Res. 2013;2(4):1086–1095.

74. Enechi OC, Ibechem Augustine C, Ugwu Okechukwu PC. Distribution of Iodine and some goitrogens in two selected water bodies (Kalawa and Adaoka Rivers) in Enugu State, Nigeria. Exp. Int. J. Sci. Technol. 2013;12(1):748-61.

75. Alum EU, Obeagu EI, Ugwu OPC, Alum BN, Arinze ED, Ukaidi CUA. Exploring the differential impacts of intermittent fasting on men and women. Elite J Health Sci. 2024;2(5):37–44.

76. Edwin N, Obasi DC, Offor CE, Obasi JN, Ugwu OPC, Aja PM, Ogbanshi ME, Uraku AJ, Alum EU, Ali FU. Impact of soil physicochemical properties on mineral composition of cassava samples from Ikwo LGA of Ebonyi State, Nigeria. J Chem Soc Niger. 2022;47(6). doi:10.46602/jcsn.v47i6.821.

77. Ikezu UJM, Ajiwe VIE, Iloh EO, Okechukwu PCU. Phytochemical and atomic absorption spectroscopic analysis of root, stem and leaf extracts of Acanthus montanus. Middle East J Sci Res. 2014;21(6):875–878.

78. Udeozo IP, Akpaba ES, Ugwu OPC, Okoye NH, Umedum NL. Qualitative alkaloidal analyses of some selected Nigerian medicinal plants used in herbal treatment of diseases. Int J Life Sci Biotechnol Pharm Res. 2013;2(3):300–305.

79. Onyeze RC, Udeh SMC, Ilo PC, Ugwu OPC. Antibacterial evaluation of Moringa oleifera leaf extract on selected bacterial pathogens (Escherichia coli, Staphylococcus aureus and Pseudomonas aeruginosa). World J Pharm Res. 2013;2(4):1065–1077.

80. Alum EU, Obasi DC, Abba JN, Aniokete UC, Okoroh PN, Ugwu OPC, Uti DE. Endogenous plant signals and human health: molecular mechanisms, ecological functions, and therapeutic prospects. Biochem Biophys Rep. 2025;43:102114. doi:10.1016/j.bbrep.2025.102114.

81. Mezieobi KC, Alum EU, Ugwu OPC, Uti DE, Alum BN, Egba SI, Ewah CM. Economic burden of malaria on developing countries: a mini review. Parasite Epidemiol Control. 2025;30:e00435. doi:10.1016/j.parepi.2025.e00435.

82. Alum EU, Nwuruku OA, Ugwu OPC, Uti DE, Alum BN, Edwin N. Harnessing nature: plant-derived nanocarriers for targeted drug delivery in cancer therapy. Phytomed Plus. 2025;5(3):100828. doi:10.1016/j.phyplu.2025.100828.

83. Nyamboga TO, Ugwu OPC, Ugwu JN, Alum EU, Eze VHU, Ugwu CN, Ejemot-Nwadiaro RI. Biotechnological innovations in soil health management: a systematic review of integrating microbiome engineering, bioinformatics, and sustainable practices. Cogent Food Agric. 2025;11(1):2519811. doi:10.1080/23311932.2025.2519811.

84. Madu CV, Alum EU, Aloh HE, Ugwu OPC, Obeagu EI, Uti DE, Egba SI, Ukaidi CUA, Alum NB. The price of progress: assessing the financial costs of HIV/AIDS management in East Africa. Medicine (Baltimore). 2025;104(18):e42300. doi:10.1097/MD.0000000000042300.

85. Ugwu OPC, Anyaegbunam CN, Uzochukwu MN, Onohuean H. Harnessing plant metabolic pathways for innovative diabetes management: unlocking the therapeutic potential of medicinal plants. Plant Signal Behav. 2025;20(1):2486076. doi:10.1080/15592324.2025.2486076.

86. Ogbodo JO, Egba SI, Ikechukwu GC, Paul PC, Mba JO, Ugwu OPC, Ezike TC. Volatile organic compound–drug receptor interactions: a potential tool for drug design in the search for remedies for increasing toxic occupational exposure. Processes. 2025;13(1):154. doi:10.3390/pr13010154.

87. Nwite MO, Agwu SC, Afiukwa CA, Ugwu OPC. Comprehensive phenotypic assessment of rice diseases in cultivated farms within Okpuitumo Community, Ikwo Local Government Area, Ebonyi State: implications for sustainable rice crop management. Newport Int J Biol Appl Sci. 2023;4(1):26–31. doi:10.59298/NIJBAS/2023/1.4.11111.

OPEN ACCESS
ONLINE ISSN: 2992-5479
PRINT ISSN: 2992-605X

88. Uraku AJ, Okechukwu PCU, Nzubechukwu E. Preliminary phytochemical screening of Spilanthes uliginosa, Ocimum basilicum, Hyptis spicigera and Cymbopogon citratus leaf extracts and haematological changes of mice infected with malaria parasite. Am Eurasian J Sci Res. 2015;10(1):12–17.
89. Enechi OC, Ogochukwu BO, Okechukwu PCU. Effect of fermentation on biochemical properties of maize (Zea mays L.). World Appl Sci J. 2014;31(5):724–729.
90. Onyeze RC, Onah GT, Nwadi NO, Ugwu OPC. Bacteriological examination of abattoir with reference to Escherichia coli and Staphylococcus species. World J Pharm Res. 2013;2(4):1154–1163.
91. Ogugua VN, Anaduaka EG, Chijioke C, Egba SI, Ugwu OPC. Effects of storage on auto-oxidation levels of selected alcoholic and non-alcoholic beverages in Nsukka town, Enugu State of Nigeria. World J Pharm Res. 2013;2(4):758–764.
92. Ogugua VN, Anaduaka EG, Chijioke C, Egba SI, Ugwu OPC. Effects of storage on auto-oxidation levels of selected alcoholic and non-alcoholic beverages in Nsukka town, Enugu State of Nigeria. World J Pharm Res. 2013;2(4):758–764.
93. Omeh YS, Ijioma VU, Ugwu OPC, Enechi OC. Characterisation and fatty acid profile of Cucurbita pepo seed oil. World J Pharm Pharm Sci. 2013;2(3):825–832.
94. Omeh YS, Ugwu OPC, Enechi OC. The effect of feeding Mucuna oil on the lipid profile and creatine kinase enzyme of albino rats. World J Pharm Pharm Sci. 2013;2(3):802–813.
95. Enechi OC, Obiora EN, Okechukwu PU. Chromatographic Identification and the Effect of the Alkaloidal Extract of Buccholzia coriaceae Seeds on the Body Weights and Relative Liver Weights of Mice. Advances in Biological Research. 2013;7(5):188-93.
96. Mezieobi KC, Alum EU, Ugwu OPC, Uti DE, Alum BN, Egba SI, Ewah CM. Economic burden of malaria on developing countries: a mini review. Parasite Epidemiol Control. 2025;30:e00435. doi:10.1016/j.parepi.2025.e00435.
97. Adachukwu P, Ifunanya C. International Journal of Research and Reviews in Pharmacy and Applied science www. ijrrpas. com.

CITE AS: Bwanbale Geoffrey David. (2026). Nutritional Interventions in Diabesity: From Caloric Restriction to Precision Diets. NEWPORT INTERNATIONAL JOURNAL OF PUBLIC HEALTH AND PHARMACY,7(1):36-44.
https://doi.org/10.59298/NIJPP/2026/713644