Review

BEFORE PREDIABETES: TARGETING INSULIN RESISTANCE WITH CULTURALLY ADAPTED LIFESTYLE INTERVENTIONS IN VIETNAMESE ADULTS OVER 50: A NARRATIVE REVIEW

Dự phòng trước giai đoạn tiền đái tháo đường: nhắm đích kháng insulin bằng các can thiệp lối sống thích ứng văn hóa ở người Việt Nam trên 50 tuổi – tổng quan tường thuật

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ABSTRACT

Objectives: Insulin resistance (IR) is the earliest, most reversible stage of metabolic dysfunction. When caught early, it may be corrected with simple lifestyle changes before it progresses to prediabetes or type 2 diabetes (T2D). In some Asian populations, IR can develop silently for years while body mass index (BMI), fasting glucose, and glycated hemoglobin (HbA1c) remain normal. This narrative review synthesizes evidence that IR can and should be detected early, while plasma glucose is still normal, and that inexpensive tools and culturally adapted nutrition and lifestyle methods should be considered, with insulin resistance as the clinical endpoint rather than diabetes. **Scope:** The review focuses on Vietnamese and other East Asian adults over 50, who are typically at normal BMI yet metabolically obese. Literature from PubMed and Google Scholar published primarily from 1999 to 2026 was synthesized. **Key content:** East Asians develop T2D at lower BMI because fat concentrates around the organs at a given body weight. This makes screening based on BMI unreliable for this population. Other tools such as the triglyceride-glucose (TyG) index or HOMA-IR identify IR in lean adults. Resistance training and other physical activity, along with adequate sleep, early time-restricted eating, and attention to micronutrients have supportive evidence for glucose or insulin outcomes. Vietnam's VPAN program improved physical activity and nutrition behaviors but did not measure insulin afterward. **Conclusions:** Insulin resistance is a practical and economical target for catching metabolic dysfunction at its root. Low-cost surrogates to the clamp, such as HOMA-IR or TyG, can be used to measure it. IR responds to everyday habits, supporting prevention before prediabetes or diabetes develops. Vietnamese intervention data using IR endpoints are absent and represent a priority research gap

Keywords: insulin resistance; insulin sensitivity; lifestyle medicine; diabetes prevention; healthy aging.

TÓM TẮT

Mục tiêu: Kháng insulin (insulin resistance – IR) là một trong những rối loạn chuyển hóa xuất hiện sớm và còn có khả năng cải thiện đáng kể. Nếu được phát hiện ở giai đoạn sớm, IR có thể được điều chỉnh bằng những thay đổi lối sống trước khi tiến triển thành tiền đái tháo đường hoặc đái tháo đường típ 2 (ĐTĐ típ 2). Ở một số quần thể châu Á, IR có thể diễn tiến âm thầm trong nhiều năm trong khi chỉ số khối cơ thể (body mass index – BMI), glucose máu lúc đói và

hemoglobin glycat hóa (HbA1c) vẫn trong giới hạn bình thường. Tổng quan tường thuật này tổng hợp các bằng chứng cho thấy IR có thể và nên được phát hiện sớm, ngay khi glucose huyết tương còn bình thường; đồng thời xem xét các công cụ chi phí thấp và các biện pháp dinh dưỡng – lối sống được điều chỉnh phù hợp với bối cảnh văn hóa, trong đó IR được xem là một tiêu chí đánh giá lâm sàng quan trọng thay vì chỉ chờ đến khi xuất hiện đái tháo đường. **Phạm vi:** Tổng quan tập trung vào người Việt Nam và các quần thể Đông Á khác trên 50 tuổi, đặc biệt nhóm có BMI bình thường nhưng vẫn có rối loạn chuyển hóa kiểu "béo phì về chuyển hóa dù cân nặng bình thường". Các tài liệu trên PubMed và Google Scholar, chủ yếu công bố trong giai đoạn 1999–2026, được tổng hợp có chọn lọc. **Nội dung chính:** Người Đông Á có thể phát triển ĐTĐ típ 2 ở mức BMI thấp hơn do có xu hướng tích lũy nhiều mỡ nội tạng hơn ở cùng một mức cân nặng. Vì vậy, sàng lọc chỉ dựa vào BMI có thể bỏ sót nguy cơ chuyển hóa. Các chỉ số như triglyceride–glucose (TyG) hoặc HOMA-IR có thể giúp nhận diện IR ở người không thừa cân. Tập luyện sức mạnh và các hình thức hoạt động thể lực khác, ngủ đủ, ăn giới hạn thời gian theo khung giờ sớm trong ngày, cùng với việc lưu ý tình trạng vi chất dinh dưỡng, đều có những bằng chứng hỗ trợ đối với các chỉ số glucose hoặc insulin. Chương trình Hoạt động thể lực và Dinh dưỡng Việt Nam (Vietnam Physical Activity and Nutrition – VPAN) đã cải thiện hành vi vận động và dinh dưỡng, nhưng không đánh giá insulin sau can thiệp. **Kết luận:** Kháng insulin là một đích dự phòng thiết thực, có chi phí hợp lý, giúp phát hiện sớm rối loạn chuyển hóa từ giai đoạn nền tảng. Có thể đo lường IR bằng các chỉ số thay thế chi phí thấp cho kỹ thuật kẹp (clamp), như HOMA-IR hoặc TyG. IR có khả năng cải thiện thông qua những thói quen hằng ngày, qua đó củng cố cách tiếp cận dự phòng trước khi tiền đái tháo đường hoặc ĐTĐ típ 2 xuất hiện. Hiện còn thiếu dữ liệu can thiệp tại Việt Nam sử dụng IR làm tiêu chí kết cục; đây là một khoảng trống nghiên cứu cần được ưu tiên.

Từ khóa: kháng insulin; độ nhạy insulin; y học lối sống; dự phòng đái tháo đường; lão hóa khỏe mạnh.

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I. INTRODUCTION

Programs to prevent metabolic dysfunction have typically waited until blood sugar tests are abnormal. Biology argues the problem starts earlier. By the time fasting glucose or HbA1c is abnormal, the root cause, which is insulin resistance (IR), has been operating in the background for years, sometimes decades. Comprehensive reviews identify IR as a precursor to diabetes, cardiovascular disease, organ injury, some cancers, and cognitive decline.[1] Separate work has framed Alzheimer's disease as a "type 3 diabetes," which makes early intervention more urgent.[2] These links motivate earlier detection; they do not prove that treating IR will prevent cancer or dementia.

If IR is the precursor of the major chronic diseases of aging, then insulin resistance, not glucose, is the endpoint that identifies risk while it is still highly reversible. This change is especially urgent in Asian populations, where IR emerges at a lower BMI and while fasting glucose and HbA1c are still normal. This causes current standard screening to underestimate metabolic risk.[3] This review has three aims: to provide evidence for insulin resistance as the

starting point for prevention; to synthesize current evidence on natural and lifestyle interventions to improve it; and to interpret the evidence for Vietnamese adults over 50. It integrates the realities of a rice-based, family-centered, fermentation-rich food culture. The intended audience is clinicians and health practitioners seeking to intervene long before prediabetes is diagnosed.

This is a narrative review. The author searched PubMed and Google Scholar for literature published primarily from 1999 to 2026, using terms including "insulin resistance," "insulin sensitivity," "HOMA-IR," "triglyceride-glucose index," "lifestyle intervention," "fermented foods," "Vietnam," and "Asian populations." The American College of Lifestyle Medicine guideline was consulted as a source of lifestyle interventions, not as a bibliographic database. Randomized controlled trials, systematic reviews, and meta-analyses were given priority for reporting insulin-sensitivity endpoints (HOMA-IR, QUICKI, the Matsuda index, or the hyperinsulinemic-euglycemic clamp), together with data specific to Asian and Vietnamese populations. This synthesis is selective, not exhaustive, and selection bias is acknowledged as a limitation.

II. MAIN CONTENT

1. Insulin resistance should be detected before glucose rises

The hyperinsulinemic-euglycemic clamp is a measure of IR. Although accurate, it is complex, expensive, and impractical for routine use. This partly explains why clinicians wait until glucose rises and miss the window to reverse IR. Two inexpensive options now close that gap: HOMA-IR, calculated from fasting glucose and insulin, and the triglyceride-glucose (TyG) index, using labs most patients already have and validated in Asian populations.[4] Their key advantage is predicting future diabetes in people with normal BMI. In a Chinese cohort of 114.293 adults, with external replication in 15.453 Japanese adults, adjusted hazard ratios for incident T2D were 4,60, 3,10, and 2,62 in non-overweight, overweight, and obese groups, a "reverse gradient" in which the relative jump in risk is largest in leaner people, arguing for early metabolic screening in lean adults.[5]

The cost of the clamp must be weighed against the cost of leaving IR undetected. Diabetes in Southeast Asia is a growing burden, and an economic evaluation in Vietnam found that annual T2D screening from age 40 rather than 45 is cost-saving.[6] That analysis addressed diabetes screening, not IR screening. If screening for established diabetes can save money, detecting its reversible precursor with a marker computed from labs already drawn has a plausible economic rationale; TyG has been shown in another health system to be more cost-effective for diagnosing IR than HOMA-IR.[7]

2. The lean insulin resistant phenotype in Asian populations

T2D develops at a lower BMI and at younger ages in Vietnamese and East Asians than in Western populations. Routine screening can be normal while profound insulin resistance is active. A comparison across four ethnic groups found Asian Americans more insulin resistant despite less obesity. This is primarily because they carry more total and visceral fat at a given

BMI.[8] Additionally, since β-cell insulin secretion is also more limited in this group, effective approaches must both improve insulin sensitivity and protect β-cell function, even when the individual is not overweight.

A WHO expert consultation recommended lower BMI action points for Asian populations.[9] Vietnamese Ministry of Health guidelines recommend screening at BMI ≥23 kg/m² with risk factors, or at age ≥45.[10] These findings suggest that measuring BMI alone misses much of the risk in this population. BMI does not consider the "metabolically obese, normal-weight" (MONW) individual. This may be because BMI is a screening number that does not identify fat distribution or actual body fat, which better reflects metabolic risk. In the largest study of metabolic syndrome among working adults in Vietnam (57.997 participants), 16% met the criteria for metabolic syndrome adapted for Asians. It is marked by high triglycerides and abdominal obesity.[11] Prevention should therefore extend beyond BMI to central adiposity, body composition, and other measures of insulin sensitivity.

3. Insulin resistance specific to the Vietnamese population

A significant obstacle is the lack of direct Vietnamese data on insulin resistance. The Vinmec Healthcare study, the largest study of metabolic syndrome in the Vietnamese population, found it rising with age to 49,6% at ≥60 years, with high triglycerides and abdominal obesity, both associated with IR.[11] The rapidly growing socioeconomic changes in Vietnam, coupled with a growing adoption of a Western diet, may contribute, yet the pathophysiology of T2D in Vietnamese people remains poorly understood, and further research is essential for effective prevention. Reference ranges for insulin sensitivity in healthy Vietnamese adults exist only for small samples under 40 years of age.[12] Values for adults over 50 remain unpublished. This review identified no Vietnamese intervention that used an insulin-resistance endpoint.

4. Natural and lifestyle interventions to prevent and reverse insulin resistance

Despite decades of evidence for early lifestyle interventions, medication is often used first in routine care. In a study of 3.234 non-diabetic at-risk adults (mean age 51), lifestyle intervention proved significantly more effective at preventing the progression of diabetes than metformin.[13] The American College of Lifestyle Medicine (ACLM) places its six lifestyle pillars: nutrition, physical activity, stress management, avoidance of risky substances, restorative sleep, and social connectedness, as first-line care for prediabetes, and notes they may apply to insulin resistance and beyond the US if they are properly tailored to specific cultural norms.[14] Each section below addresses the ACLM pillars, mindful of cultural adaptation.

Physical activity

The 2021 National Survey on Risk Factors of Noncommunicable Diseases in Vietnam reported that 22,2% of the population did not meet WHO physical-activity recommendations. This is down from 28,1% in 2015, and lower than the worldwide average; however, it is higher than in neighboring Southeast Asian countries.[15] While any movement improves insulin sensitivity, resistance training,

particularly with adequate protein, is emerging as the cornerstone. Muscle is the primary site for clearing glucose, so maintaining muscle directly protects insulin sensitivity, especially after 50 when sarcopenia becomes present. In older adults, resistance training improved HOMA-IR (mean difference −1,15) and added roughly 0,9 kg of muscle.[16]

The timing of physical activity matters. In older adults with prediabetes, three 15-minute bouts of moderate walking after meals improved 24-hour glycemic control compared with a single 45-minute walk.[17] In a study of type 2 diabetics, participants were advised to take a 10-minute walk after each meal. Results showed 12% lower postprandial glucose, with the greatest reduction after the evening meal; this reduction was greater than after a 30-minute walk at an unspecified time.[18] Even light walking intermittently can interrupt prolonged sitting and reduce postprandial glucose.[19] The evening meal in Vietnam is usually the largest and most carbohydrate-rich meal of the day. A 10-15 minute walk with others after dinner is a simple, no-cost intervention shown in clinical trials to help adults over 50. Trials supporting this finding are small and short-term. Longer studies are needed to confirm effects on HbA1c and insulin resistance.

Nutrition

Between 2012 and 2020, Vietnam population data show a rapid nutritional transition. The population is moving away from rice as the cultural staple toward more meat, dairy, sweetened beverages, ultra-processed foods, and food eaten outside the home. This shift began in cities and higher income households, but has now reached rural and lower-income households. Eating less rice does not, by itself, improve metabolic health because people replace it with less nutritious foods higher in sugar and sodium. They are eating less fruit and vegetables, and sitting more. These patterns raise postprandial glucose and insulin demand and increase visceral fat and atherogenic lipids at a lower BMI. This adds to the IR phenotype before glucose or HbA1c reach the prediabetes stage.[20] This food shift supports earlier metabolic assessment (TyG, HOMA-IR, waist) and simple dietary steps: eating vegetables and protein before rice and other carbohydrates, and reducing sugary beverages, sauces, and salt.

High fiber foods are known to improve insulin sensitivity. A systematic review and meta-analysis reported improvements in glycemic measures, including small changes in HOMA-IR.[21] For whole grains, benefits are clear after meals instead of fasting measurements. For Vietnam, it is practical to increase vegetables, legumes, and protein without eliminating rice.

A carbohydrate strategy adapted to rice culture

White rice is associated with higher T2D risk in a dose-dependent pattern.22 Rice is central to Vietnamese meals. Two small changes are recommended instead of asking families to abandon rice. First, meal sequencing—eating vegetables and protein before rice—lowers the post-meal glucose and insulin rise through delayed gastric emptying and enhanced GLP-1; in a randomized crossover study with typical Asian rice meals, eating rice first produced the highest glucose spike, while eating vegetables

or meat first, or all three together, produced lower responses.23 This reduces the burden on the pancreas, which matters given this population's limited β-cell reserve. Second, supplemental resistant starch has raised clamp measured insulin sensitivity in some protocols.24 Cooling cooked rice is a practical kitchen method for increasing resistant starch, but the size of the glucose lowering effect in Vietnamese rice dishes has not been established by the studies cited here.

Fermented foods and how they impact the gut microbiota

Fermentation pervades Vietnamese cooking (fish sauce, pickled vegetables, fermented soy) and has gained attention for potential metabolic benefit. It appears to act through the gut microbiota by increasing diversity and lowering inflammation.25 In a prediabetes trial, fermented kimchi improved HOMA-IR and QUICKI. Fresh kimchi did not have the same effect.26 Adding ferments such as kimchi or pickled vegetables to a high-fiber, minimally processed diet contributes fiber, potassium, and microbial metabolites. Two limitations apply: most trials are Korean or Japanese, and Vietnamese ferments use more salt, so lower-salt versions should be favored; these results have not been validated in Vietnamese people.

Micronutrient deficiencies

Magnesium is involved in the tyrosine-kinase activity of the insulin receptor. In a meta-analysis of nine randomized double-blind trials in 370 patients with T2D, oral magnesium for 16 weeks reduced fasting glucose.[27] That evidence supports considering magnesium status. It does not, by itself, justify routine supplementation of every adult over 50. Among botanicals, berberine has comparatively consistent trial data, lowering HOMA-IR by roughly 0,85 to 1,04. It had larger effects on fasting glucose in women, people with diabetes, and Asians. Subgroup findings need replication.[28] Berberine can cause gastrointestinal side effects and has drug interactions that matter in adults over 50 who often take several medicines.

Meal timing

Not only what we eat, but when we eat also matters. Early time-restricted eating (eTRE), or intermittent fasting with an earlier feeding window, has produced useful cardiometabolic findings, although several key trials are small. In healthy non-obese adults, an early window produced a larger HOMA-IR reduction than a mid-day window.[29] In a five-week study of early time-restricted feeding in men with prediabetes, insulin sensitivity, blood pressure, and oxidative stress improved even without weight loss.[30] A 2025 meta-analysis of 11 RCTs and 653 participants found that a 6-to-10-hour eating window without calorie restriction reduced HOMA-IR by 0,58.[31] Any plan for using TRE with the over-50-year-old population must ensure adequate protein and avoid hypoglycemia.

5. The social and family intervention of lifestyle medicine

Social connectedness is a pillar of lifestyle medicine, and in Vietnam meals are typically cooked and shared collectively. An individualized Western-style meal plan is less likely to work. The Vietnam Physical Activity and Nutrition (VPAN) program, a trial in adults aged 50 to 65 with metabolic syndrome, delivered

education, walking groups, and family meal preparation. This intervention improved physical activity and nutrition behaviors at six months.[32] Insulin was not measured. The Vietnamese family kitchen uses shared portions, cooking methods, and beverages. Changing the entire household food environment can positively shift every member's metabolic exposure at once. It can make eating carbs last, lower salt ferments, and post meal walks shared norms that benefit the entire family. For multigenerational households, family and community level delivery is likely both more appropriate and more effective than a plan handed to one person.

6. Avoidance of risky substances

The ACLM guideline for this pillar strongly recommends counseling to avoid tobacco, excess alcohol, and recreational drugs.[14] Tobacco is a key example for this population. It is a leading preventable cause of chronic disease worldwide. Smoking is associated with metabolic syndrome.[33] This has a biological, and not only a behavioral, impact. Nicotine raises catecholamines and cortisol and promotes free fatty acid release, all opposing insulin. When measured by the triglyceride-glucose index, smokers are more likely to have higher insulin resistance than non-smokers.[34] This matters in Vietnam. Almost half of men smoked at the beginning of the last decade. Although the rate of adult smokers has fallen to about one in five, male smoking and second-hand smoke remain common.[35] In a study of non-diabetic men in rural Vietnam, alcohol was associated with reduced insulin secretion (HOMA-β). Smoking was not associated with HOMA-β. In the same study, smokers had marginally lower HOMA-IR, partly explained by their lower BMI. The authors note that smoking remains an established cause of diabetes.[36] Heavy and binge drinking have been linked to impaired insulin sensitivity and β-cell function.[37] In Vietnam, three quarters of men were drinkers in 2021, and many drank at binge levels. One quarter of women were drinkers.[38] In a lean population with limited β-cell reserve, drinking even moderately is a β-cell issue. Quitting smoking and reducing heavy and binge drinking are important targets.

7. Stress management

Chronic stress is more than a simple mood change. Sustained psychological stress can activate the hypothalamic-pituitary-adrenal axis and raise cortisol. Research shows that over time, chronic stress increases visceral fat, glucose output, and insulin resistance. This forms part of a link between stress, depression, and T2D.[39] In Vietnam, rapid urbanization, long working hours, financial pressure, and caregiving for multigenerational households are common stressors. Emotional distress is rarely discussed openly. As with nutrition recommendations, presenting stress reduction as a family or community practice that affects metabolic health may be more acceptable than individual counseling.

Several low-cost natural interventions may help. In a randomized trial in people with T2D, mindfulness-based stress reduction improved glycemic control alongside well-being.[40] Breathing practices can be taught in minutes: five minutes a day of exhale-focused “cyclic sighing” reduced physiological arousal and

improved mood in a randomized trial.[41] The caveat is that these studies measured stress and mood, not insulin, so their metabolic benefit is inferred and untested with insulin endpoints in Vietnamese adults.

Meditation may be a good addition to other stress-management interventions for improving insulin resistance. In a trial of older adults with coronary heart disease, 16 weeks of Transcendental Meditation improved blood pressure and insulin resistance compared with health education alone.[42] Meta-analyses of mindfulness-based interventions in diabetes report modest improvements in HbA1c alongside reductions in psychological distress,[43,44] although findings are heterogeneous and trials are generally small. Given the long tradition of mindfulness practice in Vietnam, meditation may be a culturally acceptable, low-cost intervention for Vietnamese adults over 50.

8. Restorative sleep

Reduced and interrupted sleep increases insulin resistance and can be modified, but it is often overlooked. There is strong evidence from controlled experiments. One experiment is the landmark study restricting healthy young adults to four hours of sleep for less than a week. Results showed clear reductions in insulin sensitivity and glucose tolerance nearing a prediabetic range.[45] A systematic review and meta analysis of randomized trials confirm that sleep restriction lowers insulin sensitivity measured by HOMA-IR, the Matsuda index, and the clamp, and that timing and quality of sleep, not just duration, matter.[46] Consistently sleeping five to six hours or less predicts incident T2D, with a pooled relative risk of about 1,28.[47]

For Vietnamese adults over 50, urban noise and heat, along with increased cell phone use, shift work, and undiagnosed obstructive sleep apnea all add to poor sleep quality and duration. The targets are simple and inexpensive: seven to nine hours of sleep and maintaining consistent sleep and wake times. A consistent circadian rhythm supports insulin sensitivity. These habits work naturally with early time-restricted eating (see “Meal timing” above).

9. Interpreting international prevention models

The landmark prevention trials cited here are reference points and were studies of diabetes in higher BMI or glucose intolerant populations. They did not measure insulin resistance. The US Diabetes Prevention Program cut the incidence of diabetes by 58% (71% in adults ≥60) through modest weight loss and ≥150 minutes/week of activity[13]; the Finnish Diabetes Prevention Study achieved 58%.[48] The Chinese Da Qing study, the most relevant Asian comparison, delayed diabetes onset by almost four years. It reduced cardiovascular events and mortality over a 30-year period.[49] Two adaptations follow for Vietnamese adults over 50. Because these trials appropriately relied on weight loss in obese participants, the priority here is not weight loss. The priority for Vietnamese adults is reducing visceral and ectopic fat while preserving muscle because IR occurs at low BMI. A 5% to 7% weight-loss target is appropriate for those with central obesity. It is not an appropriate target for the normal-BMI, potentially sarcopenic older adult.

None of these studies used an insulin-resistance endpoint, the gap a Vietnamese evidence base should fill.

10. Limitations

Much of the evidence for meal timing and use of botanicals is from overweight or diabetic populations and not the lean, early IR, over-50 Asian phenotype. Applying it is a reasonable but explicit extrapolation. Most trials use HOMA-IR or QUICKI rather than the clamp, and effects on fasting HOMA-IR are often modest. Early time restricted eating has attracted attention, but several key trials are small. Most fermented food trials are from Korean or Japanese studies. Vietnamese fermented foods can be higher in salt.

11. Research gaps

This review identified no Vietnamese intervention that used an insulin resistance endpoint (HOMA-IR, QUICKI, Matsuda, or clamp). Insulin resistance and TyG reference values for Vietnamese adults over 50 were not found. The lean MONW phenotype has not been identified with body composition imaging. Interventions specific to this culture (eating carbs last, family and community delivery) have not been tested in Vietnamese populations with insulin resistance as the endpoint. The costs of early IR detection versus downstream diabetes costs have not been identified for Vietnam.

III. CONCLUSION

Diabetes is rising worldwide, and faster in Asia. Insulin resistance is the earliest and most modifiable step before prediabetes. In Asian populations, IR can develop at a normal BMI and while glucose remains normal, so it is routinely missed until later, less reversible stages. Shifting prevention to target insulin resistance rather than diabetes can enable earlier detection using accessible options such as the TyG index or HOMA-IR. IR may improve through resistance training, higher fiber foods, culturally adapted carbohydrate strategies, fermented vegetables, early time-restricted eating, and attention to nutrient deficiencies, delivered through the family, not only the individual. This offers a realistic route for catching metabolic dysfunction at its root in Vietnamese adults over 50. The priority need is a Vietnamese evidence base that measures insulin resistance itself.

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