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Balancing Insulin, Balancing Monastic Life: An Integrative Review of Middle Path Lifestyle Practices for Metabolic Health in Buddhist Monastic Communities

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Abstract

Noncommunicable diseases are prevalent among Thai Buddhist monks. Reliance on alms, prolonged sedentary study and meditation, and limited control over donated food create a distinctive metabolic risk profile. Insulin resistance may contribute to obesity, type 2 diabetes, hypertension, and dyslipidemia in this population. This integrative narrative review examines five lifestyle domains—meal timing, food quality, movement, sleep, and meditation—in relation to insulin action, organises the evidence within a Buddhist Middle Path framework, and assesses claims commonly used in monastic health education. The review was anchored in a Thai-language health-education volume produced under a national research fund and supplemented by targeted searches of PubMed and publisher records. Cited sources were checked against their DOI records. Monastic studies indicate a substantial burden of obesity, hypertension, and dysglycemia despite a naturally compressed eating window. Evidence is strongest for improving food quality through a Mediterranean-style dietary pattern, engaging in regular physical activity and interrupting prolonged sitting, and obtaining adequate sleep. Evidence for meditation as an intervention for stress and blood pressure is moderate, whereas evidence for time-restricted eating and proposed autophagy-related mechanisms remains limited to small, short-term trials. Several widely quoted effect sizes could not be verified in the sources cited for them. A temple-level programme combining education for lay donors, environmental changes, and links to clinical care is biologically plausible and culturally congruent. Its effectiveness among monks requires cluster-randomised evaluation before efficacy claims can be made.

Keywords: insulin resistance; Buddhist monks; time-restricted eating; lifestyle medicine; Middle Path; noncommunicable diseases; Thailand

1. Introduction

Buddhist monks in Thailand, who make up roughly 0.3% of the population, act as community leaders and moral exemplars, so their health matters both for the individuals and for the communities that depend on them (Jeamjitvibool et al., 2022). Globally, an estimated 828 million adults were living with diabetes in 2022, and the largest increases since 1990 occurred in low- and middle-income countries, including in Southeast Asia (NCD Risk Factor Collaboration [NCD-RisC], 2024). Thai national surveys have documented a substantial burden of diabetes and related metabolic risk factors (Aekplakorn et al., 2011), and monastic communities are not spared.

An integrative review of 22 studies found that obesity and hypertension were the most prevalent noncommunicable diseases (NCDs) among Thai monks and that religious beliefs and practices shape the social determinants of their health (Jeamjitvibool et al., 2022). In a cross-sectional study of 415 monks aged 35 years or older in Chanthaburi Province, 10.8% had diabetes and 11.8% had impaired fasting glucose; their diet was often energy-dense and high in sodium, featuring chili pastes, coconut-based curries, and fried foods (Kuramasuwan et al., 2013). A Ministry of Public Health behaviour-change programme for 4,786 at-risk monks in the upper northeast region was followed by lower fasting

blood sugar, body mass index, and risk scores over six months, although the pre–post design without a comparison group limits causal inference (Noo-In et al., 2022). Provincial screening data for 4,900 monks in Khon Kaen, summarised in the volume that anchors this review, reported hypertension risk in 12.27%, diabetes risk in 26.94%, and overweight in 21.48% (Ruangsan et al., 2026); these figures derive from a government release and have not been peer reviewed.

Insulin resistance links these conditions mechanistically, yet health advice reaches monks in fragments: avoid sweets, walk more, meditate. A Thai-language health-education volume produced under a Fundamental Fund project on volunteer monk caregivers in Mueang Khon Kaen District (Ruangsan et al., 2026) sought to unify such advice under one metaphor, insulin as a "switch" that steers the body between fat storage and fat oxidation, and under the Buddhist principle of *majjhima paṭipadā*, the Middle Path. The volume is written for monks, caregiving novices, and lay donors, and it quotes numerical effect sizes from many studies. Whether those claims withstand scrutiny, and how the framework maps onto primary evidence, has not been examined.

This article therefore has three aims: (a) to synthesise verified evidence on five lifestyle domains in relation to insulin action; (b) to propose an integrative Middle Path framework suited to monastic conditions; and (c) to appraise, transparently, the strength of evidence behind claims commonly used in monastic health education.

2. Method

This is an integrative narrative review, not a systematic review; no protocol was registered and no PRISMA flow diagram is presented. Three steps were followed. First, the full text of the anchor volume (Ruangsan et al., 2026; four chapters on insulin and monastic health, Dhamma-based practices, temple health culture, and a "switch" model, plus appendices) was read to extract its practice components and quantitative claims. Second, targeted searches of PubMed and publisher records were conducted in September 2026 for each domain and for monastic populations, prioritising systematic reviews, randomised trials, large cohorts, and guideline statements. Third, every source cited here was verified against its DOI record (title, authors, journal, volume, pages); records that did not match their DOI were excluded. Because verification was record-level, effect sizes attributed to a source are those visible in its abstract or publisher page, and claims that could not be confirmed at that level are labelled as such. Evidence strength was graded qualitatively by design (systematic review or randomised trial, small trial, observational study, mechanistic or preclinical) rather than with a formal instrument. The lead author is also a co-author of the anchor volume; this is declared as a competing interest.

3. Insulin Resistance and the Monastic Metabolic Context

3.1 Physiological background

After a meal, insulin promotes glucose uptake by skeletal muscle and adipose tissue, suppresses hepatic glucose output, and restrains lipolysis. Insulin resistance is a blunted response to this signal, driven in large part by ectopic lipid accumulation and inflammatory signalling that impair insulin-receptor pathways in liver and muscle (Petersen & Shulman, 2018; Samuel & Shulman, 2016; Zhao et al., 2023). Compensatory hyperinsulinaemia can maintain normal glucose for years, but progressive β-cell failure eventually produces type 2 diabetes (Kahn et al., 2014). Fasting glucose and insulin can be combined into surrogate indices such as the homeostasis model assessment (HOMA-IR; Matthews et al., 1985) and the quantitative insulin sensitivity check index (QUICKI; Katz et al., 2000). Both depend on insulin assays that differ between laboratories and have no universal cut-offs, so the insulin "zones" expressed in μU/mL in practice-oriented materials should be treated as heuristics until locally validated.

3.2 The monastic paradox

Monastic discipline restricts solid food after midday, and the anchor volume describes many monks eating one main meal in the morning (Ruangsan et al., 2026). This resembles early time-restricted eating, yet obesity, hypertension, and dysglycemia remain common (Jeamjitvibool et al., 2022; Kuramasuwan et al., 2013). The apparent paradox is informative: a compressed eating window does not by itself protect metabolic health when the food offered is energy-dense, when movement is limited by study and seated practice, and when sleep and stress are not addressed. It motivates a multi-

domain rather than single-behaviour approach.

4. Five Middle Path Domains

Table 1 summarises the five domains, their monastic context, and the best verified evidence; the subsections below discuss each and its limits.

Table 1. Five Middle Path domains: monastic context, rationale, and verified evidence

Domain	Monastic context	Mechanistic rationale	Best verified evidence	Evidence strength
Meal timing	Solid food restricted after midday; one main meal common (Ruangsan et al., 2026)	Longer overnight fast; alignment with circadian metabolism	Early TRE improved insulin sensitivity in prediabetes (Sutton et al., 2018; crossover, 5 weeks); 10-h TRE improved markers in metabolic syndrome (Wilkinson et al., 2020; single-arm, n = 19); no advantage over calorie restriction at 12 months (Liu et al., 2022)	Limited–moderate
Food quality	Alms food often energy-dense, high in sodium and refined starch (Kuramasuwan et al., 2013)	Lower glycaemic load; unsaturated fat; fibre; satiety from protein	Mediterranean diet with olive oil or nuts reduced major cardiovascular events (Estruch et al., 2018); food order lowered postprandial glucose and insulin (Shukla et al., 2015)	Strong (CVD); moderate (glycaemia)
Movement	Long seated study and meditation; alms round, walking meditation, chores	Insulin-independent muscle glucose uptake; lower post-meal glycaemia	Post-meal walking lowered glycaemia vs single daily walk (Reynolds et al., 2016); benefits at low volumes (Warburton & Bredin, 2017); position statement (Colberg et al., 2016)	Strong
Sleep	Pre-dawn rising; late-night activity may shorten sleep	Cortisol, sympathetic activity, glucose tolerance	Short and long sleep and sleep difficulty predicted incident diabetes (Cappuccio et al., 2010); sleep restriction impaired glucose tolerance (Spiegel et al., 1999)	Moderate–strong
Mind training	Daily meditation and chanting; reflection on food before eating	Lower stress reactivity and cortisol; self-regulation of eating	Meditation reduced cortisol, CRP, and blood pressure vs active controls (Pascoe et al., 2017); no extra weight loss but lower fasting glucose at 18 months (Daubenmier et al., 2016)	Moderate (stress, BP); limited (insulin)

4.1 Meal timing, one-meal-a-day practice, and autophagy

The practice of *ekāsanika*, eating a single meal, is presented in the anchor volume as the most potent way to lower insulin and lengthen the overnight fast. Intermittent fasting and time-restricted eating (TRE) have been widely reviewed (Mattson et al., 2017; Patterson & Sears, 2017; de Cabo & Mattson, 2019), and eating earlier in the day is biologically attractive because glucose tolerance and insulin sensitivity follow circadian rhythms (Longo & Panda, 2016). In a five-week crossover trial of men with prediabetes, early TRE with a six-hour window improved insulin sensitivity, β-cell responsiveness, blood pressure, and oxidative stress without weight loss (Sutton et al., 2018). A four-day crossover study of 11 overweight adults found lower mean 24-hour glucose (by 4 mg/dL) and altered expression of circadian-clock and autophagy-related genes (Jamshed et al., 2019), and a 12-week single-arm trial of 19 patients with metabolic syndrome reported improved weight, blood pressure, and atherogenic lipids with 10-hour TRE (Wilkinson et al., 2020).

Larger and longer trials are more sober. In a 12-week randomised trial, 16:8 TRE produced modest weight loss that did not differ significantly from consistent meal timing (Lowe et al., 2020), and in a 12-month trial of 139 adults with obesity, calorie restriction with TRE did not outperform calorie restriction alone (−8.0 vs −6.3 kg; $P = .11$; Liu et al., 2022). Evidence that timing improves insulin sensitivity independently of energy intake therefore rests on small, short studies, and no trial has tested a one-meal-a-day pattern in monks. Reviews of religious fasting likewise describe heterogeneous effects that depend on the pattern followed (Trepanowski & Bloomer, 2010).

The anchor volume also links prolonged fasting to autophagy, proposing that low insulin and high AMPK activity switch off mTOR and release cellular repair. The molecular logic is well founded

(Kim et al., 2011; Mizushima & Komatsu, 2011; Saxton & Sabatini, 2017; Levine & Kroemer, 2019), and reviews conclude that fasting and calorie restriction induce autophagy in many tissues (Bagherniya et al., 2018). However, autophagy is a dynamic flux that cannot be inferred from gene expression alone, and consensus guidelines caution against simple readouts (Klionsky et al., 2021). Specific human thresholds, such as autophagy beginning at 16–24 hours or at a given insulin concentration, have not been established, and should be presented as hypotheses. For older monks, or those taking sulfonylureas or insulin, extended fasting also carries a hypoglycaemia risk; trials of rapid dietary change in type 2 diabetes stress concurrent medication management by clinicians (Hallberg et al., 2018).

4.2 Food quality

Food quality has the firmest evidence. In a Spanish trial of 7,447 high-risk adults, a Mediterranean diet supplemented with extra-virgin olive oil or nuts reduced major cardiovascular events relative to a control diet (Estruch et al., 2018); the report was republished in 2018 with analyses that do not rely solely on randomisation after protocol deviations were identified. For monks, the translatable elements are practical: brown or whole-grain rice instead of refined rice, more vegetables, fish, legumes, and tofu, unsaturated cooking oils, and fewer fried dishes and sugary drinks, which addresses the energy-dense, high-sodium patterns observed in monastic diets (Kuramasuwan et al., 2013). Eating vegetables and protein before carbohydrate lowered postprandial glucose and insulin in a small crossover study (Shukla et al., 2015), a low-cost tactic compatible with alms-bowl eating. Because monks eat what is offered, food quality is a lay-donor issue as much as an individual one (Section 6).

4.3 Movement and sedentary time

Physical activity improves insulin sensitivity through insulin-independent glucose uptake by contracting muscle, and the American Diabetes Association recommends regular activity and interruption of prolonged sitting (Colberg et al., 2016). Health benefits accrue at relatively small volumes of activity (Warburton & Bredin, 2017). In 41 adults with type 2 diabetes, advice to walk for 10 minutes after each main meal lowered post-meal glycaemia more than advice to walk 30 minutes once daily (ratio of geometric means 0.88; 0.78 after the evening meal; Reynolds et al., 2016). Sedentary time shows dose–response associations with mortality and type 2 diabetes independent of activity (Patterson et al., 2018), although findings for incident disease and insulin-resistance markers were mixed in earlier syntheses (Thorp et al., 2011), and no specific sitting threshold has been validated. Monastic life offers natural opportunities: the alms round (*piṇḍapāta*), walking meditation (*caṅkama*), and temple chores can be framed as scheduled movement, and long periods of seated study or meditation can be broken with brief walking.

4.4 Sleep and circadian regularity

Experimental restriction of sleep to four hours for six nights impaired glucose tolerance and raised evening cortisol in 11 young men (Spiegel et al., 1999). In a meta-analysis of prospective cohorts, short sleep (≤5–6 hours), long sleep (>8–9 hours), difficulty initiating sleep, and difficulty maintaining sleep were associated with relative risks of incident type 2 diabetes of 1.28, 1.48, 1.57, and 1.84, respectively (Cappuccio et al., 2010). The U-shaped pattern implies that regularity and quality, not simply longer sleep, are the target. Monastic schedules that begin before dawn for chanting and alms round are compatible with health only if bedtime is correspondingly early; circadian-aligned schedules for sleep and eating are also central to current models of metabolic regulation (Longo & Panda, 2016; Patterson & Sears, 2017).

4.5 Meditation, mindful eating, and stress

Meditation is a core monastic practice with plausible metabolic relevance through lower stress reactivity. A meta-analysis of 45 randomised trials with active controls found that meditation reduced cortisol, C-reactive protein, blood pressure, heart rate, triglycerides, and tumour necrosis factor-α (Pascoe et al., 2017), and a review of 47 trials found moderate evidence of benefit for anxiety, depression, and pain (Goyal et al., 2014). Evidence for direct effects on insulin and weight is weaker. A mindfulness programme for stress eating did not change weight or abdominal fat overall, although obese participants showed reduced cortisol awakening response and improvements in mindfulness and chronic stress tracked abdominal-fat reductions (Daubenmier et al., 2011). In 194 adults with obesity,

adding mindfulness training to a diet-and-exercise programme did not produce significant additional weight loss but was associated with a lower fasting glucose at 18 months (−4.1 mg/dL; P = .01; Daubenmier et al., 2016). Neuroimaging studies suggest changes in regions involved in self-regulation (Hölzel et al., 2011; Tang et al., 2015), though such findings are mechanistic and derive from small samples. Meditation is thus best positioned as a stress and blood-pressure intervention with possible secondary metabolic benefit.

5. Evidence Appraisal of Commonly Quoted Claims

Practice-oriented health education often condenses complex evidence into memorable percentages. Table 2 lists claims as they appear in the anchor volume and compares them with the records cited for them or with the closest verified evidence. The purpose is not to discount the volume's practical advice, most of which is directionally consistent with the literature, but to distinguish direction of effect from magnitude, and to identify figures that should be re-derived from full texts before being repeated. Several figures, such as the 58% reduction in diabetes incidence, belong to multi-component interventions in high-risk populations (Knowler et al., 2002) and should not be attributed to a single behaviour. Others could not be confirmed at abstract level and are flagged as unverified.

Table 2. Claims quoted in monastic health education compared with verified evidence

Claim as quoted in the anchor volume	Related record	What the record shows	Status
Mindful eating lowers insulin by about 18% within 4 weeks	Daubenmier et al. (2016)	RCT (n = 194): no significant extra weight loss; fasting glucose −4.1 mg/dL at 18 months; no 18% insulin effect reported in the abstract	Not supported as stated
A 7% weight loss cuts type 2 diabetes risk by 58%	Knowler et al. (2002)	Intensive multi-component lifestyle programme (weight and activity goals) reduced incidence by 58% in adults with impaired glucose tolerance	Supported, but multi-component and population-specific
Autophagy begins after 16–24 h of fasting when insulin falls below about 6 μU/mL	Bagherniya et al. (2018); Jamshed et al. (2019); Klionsky et al. (2021)	Fasting induces autophagy across tissues; a 4-day trial (n = 11) altered an autophagy-related gene in blood cells; no validated human time or insulin thresholds	Hypothesis
Sitting more than 2 h markedly raises risk of insulin resistance	Patterson et al. (2018); Thorp et al. (2011)	Dose–response with mortality and type 2 diabetes; mixed findings for incident disease and insulin-resistance markers; no validated threshold	Direction supported; threshold not
Sleeping under 6 h for one week cuts insulin sensitivity by 30%	Spiegel et al. (1999); Cappuccio et al. (2010)	6 nights of 4-h sleep impaired glucose tolerance (n = 11); habitual short sleep RR 1.28 for diabetes; 30% figure not reported in abstracts	Direction supported; magnitude unverified
Meditation 20 min/day for 8 weeks lowers cortisol by 25%	Pascoe et al. (2017); Goyal et al. (2014)	Meditation lowered cortisol vs active controls; pooled magnitude not reported in the abstract	Direction supported; magnitude unverified
One meal a day or fasting cuts diabetes risk by over 50% and lengthens telomeres by 8–10%	Lowe et al. (2020); Liu et al. (2022); de Cabo & Mattson (2019)	Large RCTs show modest weight loss with TRE, similar to control; no verified trial reporting these figures was located	Not supported

6. An Integrative Middle Path Framework for Temples

Figure 1 integrates the five domains. The Middle Path is used as an organising principle rather than as evidence: it directs attention to avoiding both excess (energy-dense food, prolonged inactivity) and deprivation (extreme fasting, sleep loss), which is consistent with the heterogeneous and sometimes null findings above. The framework has three enabling layers.

Lay-donor engagement. Because monks depend on offered food, donor education is likely to be the highest-leverage food-quality intervention, for example through suggested menus and information displayed where alms food is offered (Ruangsan et al., 2026). This layer is currently

supported by expert opinion and qualitative reports rather than by trials. Temple environment. Walking paths, movement built into daily routines, and shared health-promoting activities create conditions for sustained change. Clinical linkage and monitoring. Periodic screening of blood pressure, waist circumference, fasting glucose, and lipids allows early detection, and clinicians can adjust medications when diet or fasting changes; the Ministry of Public Health programme provides a scalable precedent for routine monitoring in monastic populations (Noo-In et al., 2022). Healthy lifestyle in general is strongly associated with longevity: in two large US cohorts, adherence to five low-risk lifestyle factors was associated with a hazard ratio for all-cause mortality of 0.26 (Li et al., 2018), although these data are from lay populations and cannot be assumed to transfer directly to monastic settings.

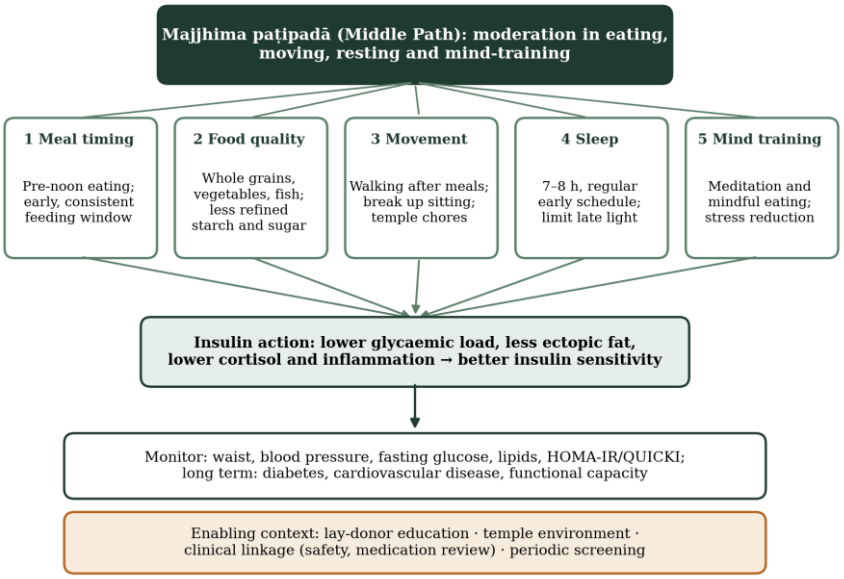


Figure 1. Integrative Middle Path framework for metabolic health in monastic communities
Note. The framework is conceptual; arrows denote hypothesised pathways rather than demonstrated effects in monks.

7. Discussion

This review makes three contributions. First, it clarifies that monastic metabolic risk is not explained by meal timing, and that a multi-domain view is needed. Second, it maps Buddhist practices, namely restraint in eating, walking, sleep regularity, and meditation, onto domains with verifiable physiological rationale. Third, it shows how the strength of evidence differs across domains, and provides a template for separating direction from magnitude in health education materials, which may be useful to other faith-based communities.

The “insulin switch” metaphor is a useful teaching device, but it simplifies. Insulin is one of several regulators of substrate use, its effects vary by tissue and dose, and low fasting insulin is a marker rather than a proven lever (Petersen & Shulman, 2018). Overstating precision can erode credibility with clinicians and donors alike. Equally, the religious framing should not lead to selective reading of evidence; Middle Path teaching supports the moderation that trials tend to favour, but it does not make any single regimen effective.

Limitations include the narrative design, the absence of a registered protocol or exhaustive search, reliance on record-level verification for some effect sizes, and dependence on a single anchor volume whose lead author overlaps with the present authorship. Most primary evidence derives from lay populations, and only observational and pre–post studies exist in monks. Older monks, those with existing diabetes, and those taking glucose-lowering drugs may respond differently and face different risks.

Priorities for research follow directly. Cluster-randomised or stepped-wedge trials at the temple level should test a multi-domain programme against usual care, with blood pressure, waist circumference, fasting glucose, HbA1c, and standardised insulin-based indices as outcomes. Safety data for one-meal-a-day patterns in older monks, including hypoglycaemia, sarcopenia, and nutritional adequacy, are needed before such patterns are promoted. Continuous glucose monitoring could quantify

the effect of alms-food composition and post-meal walking. Finally, trials of lay-donor education should measure changes in the food actually offered, not only donor knowledge.

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8. Conclusion

Insulin resistance offers a coherent physiological thread through the metabolic risks facing Thai monks, and the Middle Path offers a culturally resonant frame for addressing it through food quality, movement, sleep, meditation, and cautious meal timing. The strongest evidence supports food quality, physical activity, and sleep; meditation is best supported as a stress intervention; and time-restricted eating and autophagy-based claims remain hypotheses for this population. A temple-level programme that engages lay donors and links to clinical care is a promising and testable next step.

Declarations

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Competing interests. The lead author is a co-author of the Thai-language volume that anchors this review (Ruangsan et al., 2026). No other competing interests are declared.

Ethics. Not applicable; this review used published sources only and involved no human participants.

Data availability. No new datasets were generated. All cited sources are identified by DOI, except the anchor volume, which is identified by ISBN.

Generative AI. Generative AI (Claude, Anthropic) assisted with drafting and record-level reference checking. The authors reviewed and take responsibility for all content.

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