

Intermittent Fasting for Population-Level Non-Communicable Diseases Prevention in Bangladesh: Bridging Global Evidence and Local Practice

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ORIGINAL ARTICLE

Abstract:

Intermittent fasting (IF) is an increasingly popular dietary approach involving cycles of eating and fasting that is recognized for its potential to improve metabolic health. Non-communicable diseases (NCDs), including cardiovascular diseases (CVDs), diabetes, cancer, and chronic respiratory diseases, caused ~43 million deaths in 2021, accounting for 75% of all non-pandemic-related deaths globally (World Health Organization [WHO]). According to the WHO, ~19.8 million people died from CVDs in 2022, while ~10 million died from cancer in 2020 worldwide. The WHO also reports that >2.5 billion adults are overweight, >1 billion are living with obesity, and >830 million have diabetes globally. In addition, ~545 million people were living with chronic respiratory diseases in 2017 (the Lancet). In Bangladesh, NCDs account for ~71% of all deaths, with nearly half occurring prematurely (WHO, 2026). This burden is driven by rapid urbanization, sedentary lifestyles, unhealthy dietary habits, and increasing metabolic risk factors such as obesity, hypertension, and dyslipidemia. Evidence indicates that IF improves metabolic health through metabolic switching, enhanced insulin sensitivity, improved lipid metabolism, increased

autophagy, and reduced inflammation and oxidative stress, thereby lowering major NCDs risk factors, including obesity, hyperglycemia, dyslipidemia, and hypertension. As a low-cost, non-pharmacological intervention with strong cultural acceptability, IF represents a feasible and evidence-based strategy for NCDs prevention. Integrating IF into Public health policy and practice may contribute to reducing Bangladesh's growing NCDs burden and improving population health.

Keywords: Intermittent Fasting, Non-Communicable Diseases, Primary Prevention, Public Health, Bangladesh.

Historical Background:

Fasting has been practiced for centuries across major civilizations for religious, ethical, and health-related purposes. While ancient physicians such as Hippocrates used fasting as a therapeutic intervention, religious traditions primarily emphasized spiritual discipline rather than metabolic health. Scientific interest in fasting emerged in early 20th century with Benedict's fasting studies in 1915, followed by research on caloric restriction (CR) and longevity, which ultimately led to the development of IF as a strategy to improve

metabolic and cellular health (Longo & Mattson, 2014; Visioli et al., 2022).

Conceptual Framework:

Intermittent fasting is a dietary strategy that alternates structured periods of voluntary fasting with defined eating windows, emphasizing the timing of food intake rather than continuous CR or specific dietary composition. Its physiological effects arise from prolonged fasting, which depletes glycogen stores and triggers a metabolic switch from glucose to fatty acids and ketone bodies, thereby improving insulin sensitivity, lipid metabolism, autophagy, and cellular resilience (de Cabo & Mattson, 2019; Mattson et al., 2018; Mattson, 2025).

Comparison with Caloric Restriction:

CR is often compared with IF, but the two differ fundamentally. CR involves a constant daily energy deficit while maintaining adequate nutrition, whereas IF alternates periods of fasting-induced energy deficit with periods of normal or unrestricted eating (Anton et al., 2017; Visioli et al., 2022). Physiologically, IF creates repeated fasting-refeeding cycles that shift the body between catabolic, stress-resistant states and anabolic, growth-promoting states, unlike the sustained energy deficit produced by CR (Mattson et al., 2018; Mattson, 2025). Although these cyclical transitions may offer theoretical advantages, current evidence indicates that IF and CR generally produce comparable effects on weight loss and metabolic health, with only modest advantages of IF for insulin sensitivity and, in some cases, adherence (Mattson, 2025; Patterson & Sears, 2017; Anton et al., 2017).

Common Types:

Intermittent fasting is not a single, uniform intervention but an umbrella term encompassing several distinct dietary protocols that differ in the duration, frequency, and pattern of fasting and eating intervals.

1. **16:8 Method:** It is also known as time-restricted eating (TRE), limits food intake to an 8-hour daily eating window followed by a 16-hour fasting period. Unlike continuous CR, TRE emphasizes the timing of food intake rather than CR. Studies have reported that this approach promotes weight loss and produces modest improvements in blood pressure, insulin sensitivity, and lipid profiles, with greater benefits observed when food intake is aligned with circadian rhythms (Gabel & Varady, 2020; Derron et al., 2025).

2. **5:2 Diet (Intermittent Energy Restriction):** Individuals eat normally for 5 days each week and restrict their energy intake to ~500-600 kcal on 2 non-consecutive days. Evidence suggests that the 5:2 diet produces weight loss and metabolic improvements comparable to those achieved with continuous energy restriction while also reducing insulin resistance and breast cancer risk markers (Harvie et al., 2011).
3. **Eat Stop Eat:** This protocol involves one or two 24-hour fasts per week, with unrestricted eating on the remaining days. Full-day fasting promotes a more complete metabolic switch from glucose to fat and ketone utilization, contributing to weight loss and improved glycemic control, similar to other intermittent energy restriction protocols (Longo & Mattson, 2014; Varady et al., 2009).
4. **Alternate-Day Fasting:** This protocol alternates fasting days, during which individuals consume either no calories or ~25% of their daily energy requirements, with days of unrestricted eating. It is one of the most extensively studied IF protocols, producing significant weight and fat loss while preserving lean body mass. Its effectiveness is comparable to daily CR and may exceed TRE for fat loss (Varady et al., 2013; Trepanowski et al., 2017; Varady et al., 2022).
5. **Ramadan Style Fasting:** It involves abstaining from food and fluids from dawn to sunset for 1 month. Unlike other IF protocols, it combines daytime fasting with nighttime eating and altered sleep patterns. Studies have reported improvements in body weight, waist circumference, blood pressure, lipid profile, and inflammatory markers; however, the effects on insulin resistance remain inconsistent (AlZunaidy et al., 2023; Hasan et al., 2022; Besbes et al., 2022).
6. **Modified Fasting:** It allows ~20-25% of the usual calorie intake on fasting days instead of complete abstinence from food. This approach improves adherence while maintaining fasting benefits, achieving weight loss and LDL cholesterol and triglyceride (TG) reductions comparable to stricter fasting protocols (Harvie et al., 2010; Varady et al., 2009).

NCDs and the Global Perspective:

- **Scale of the Problem:** NCDs, primarily CVDs, cancers, chronic respiratory diseases, and diabetes, are the leading global health challenge of the 21st

century. In 2021, they caused ~43 million deaths, accounting for ~75% of all non-pandemic-related deaths worldwide. Of the 18 million premature NCDs deaths that occurred before age 70, 82% were in low- and middle-income countries (LMICs). CVDs were the leading cause (>19 million deaths), followed by cancers (10 million), chronic respiratory diseases (4 million), and diabetes, including kidney complications (>2 million) (Support, 2022).

- **An Unequal and Widening Burden:** LMICs bear 73% of NCDs deaths despite limited chronic care capacity. By 2050, global NCDs deaths are projected to reach 75.5 million and 2.44 billion DALY, driven by CVDs (86.1% of deaths), urbanization, unhealthy lifestyles, and population aging. Most countries remain off-track to achieve the Sustainable Development Goal (SDG 3.4) target of reducing premature NCDs mortality by one third by 2030 (WHO, 2025a; WHO, 2025b; Freihart et al., 2025).
- **Health-System Costs:** Beyond mortality, NCDs impose major economic costs, highlighting the need for low cost, scalable preventive strategies such as IF to complement clinical care.

NCDs and Bangladesh Context:

Bangladesh faces a rising burden of NCDs and mental health disorders. NCDs account for ~71% of all deaths and about 300,000 premature deaths annually, while major risk factors, including tobacco use (>45% of adults), physical inactivity (two-thirds of adolescents), hypertension (1 in 4 adults), and diabetes (1 in 10 adults), remain highly prevalent. Mental health conditions affect nearly 1 in 5 adults and 12% of children and adolescents, with an estimated 6,000 suicides annually, highlighting the need for scalable prevention strategies. Near-universal Ramadan observance offers a promising opportunity for population-level NCDs prevention (Permanent Mission of Bangladesh to the United Nations, New York, 2025).

Economic Burden of NCDs in Bangladesh:

Bangladesh, a LMIC, is undergoing a rapid epidemiological transition driven by urbanization, unhealthy diets, physical inactivity, and population aging, leading to a growing burden of NCDs. LMICs account for 73% of global NCDs deaths and 81% of DALY losses (WHO, 2025; Global Health Estimates: Leading Causes of DALYs, n.d.). In Bangladesh, high out of pocket health spending and limited insurance

push ~5 million people into poverty annually, with 43% of affected households resorting to borrowing or selling assets (Khan et al., 2017; Sarker et al., 2021). Diabetes alone causes >813,000 excess deaths and 9.2 million productivity adjusted life years (PALYs) lost among working age adults (Afroz et al., 2020). Bangladesh is among the LMICs driving rising NCDs-related DALY losses (35%), with 86% of premature NCDs deaths occurring in LMICs, exacerbating productivity and economic losses (Rahman et al., 2026; Support, 2022).

Positioning IF Within the Global NCDs Response:

Global and national NCDs burden highlights IF as a low-cost, culturally adaptable, and scalable strategy for improving weight, blood pressure, and lipid profiles that should complement established NCDs prevention measures.

- **Rising Obesity Epidemic:** Global adult obesity has more than doubled since 1990, affecting >1 billion people by 2022. As a major driver of cardio-metabolic disease and healthcare costs, obesity has increased interest in sustainable dietary strategies such as IF, which targets both calorie intake and meal timing (WHO, 2025; Phelps et al., 2024).
- **Type 2 Diabetes (T2D) Crisis:** Diabetes affects ~589 million adults worldwide (with type 2 accounting for 90-95%) and is projected to reach ~853 million by 2050. This growing burden has increased interest in IF, as its metabolic effects may improve insulin sensitivity and glucose regulation (Diabetes Atlas, 2026; Duncan et al., 2025; De Cabo & Mattson, 2019).
- **Rising Burden of Hypertension:** It affects ~1.4 billion adults worldwide in 2024, many of whom remain undiagnosed or inadequately treated. Its growing burden has increased interest in IF as a complementary lifestyle strategy, given evidence of modest reductions in systolic and diastolic blood pressure (WHO, 2025a; Varady et al., 2022).
- **Metabolic Syndrome:** Metabolic syndrome - a cluster of obesity, hypertension, dyslipidemia, and insulin resistance - has become a major global concern. Prevalence rose to 31.0% in women and 25.7% in men by 2023, affecting ~1.54 billion adults worldwide. By improving multiple cardio-metabolic risk factors, IF has emerged as a comprehensive lifestyle intervention (Noubiap et al., 2025; Hamooya et al., 2025).

Global Overweight and Obesity Epidemic:

Overweight and obesity are global public health

challenges recognized by the WHO as chronic, relapsing diseases driven by environmental, socioeconomic, psychosocial, and genetic factors (WHO, 2025c).

- **Overweight in Young Children:** In 2024, ~35 million children under 5 were overweight, with the burden increasingly concentrated in LMICs. Early-life overweight often persists into adolescence and adulthood and increases the risk of early metabolic complications (WHO, 2025c; World Obesity Atlas 2024, n.d.).
- **Overweight and Adolescent Obesity:** In 2022, >390 million children and adolescents (5-19 years) were overweight, including 160 million with obesity. Childhood obesity increased from ~2% (1990) to 8% (2022), with projections indicating continued rises through 2050 without effective intervention (WHO, 2025c; Phelps et al., 2024; Kerr et al., 2025).
- **Global Prevalence in Adults:** In 2022, 2.5 billion adults (43%) were overweight, including 890 million (16%) with obesity. Adult obesity has more than doubled since 1990 and is rising rapidly in LMICs, driven by urbanization and dietary transitions (WHO, 2025c; Data, 2024; Phelps et al., 2024).
- **Implications:** Global rise in obesity increases the burden of type 2 diabetes, hypertension, metabolic syndrome, and CVDs, highlighting the need for sustainable dietary strategies such as IF to improve energy balance and metabolic health (Ng et al., 2025; De Cabo & Mattson, 2019).

Global Diabetes Burden:

- **Global Prevalence:** WHO estimates that adults with diabetes increased from 200 million in 1990 to 830 million in 2022, while prevalence nearly doubled from 7% to 14%. The IDF's 11th Diabetes Atlas estimates 589 million adults aged 20-79 was living with diabetes in 2024. More than half of affected adults were untreated in 2022, with the lowest treatment coverage in LMICs (WHO, 2024; Diabetes Atlas, 2026 & Duncan et al., 2025).
- **Faster Rise in LMICs - Case of Bangladesh:** Diabetes epidemic is growing disproportionately in LMICs, which now hold roughly 4 in 5 of the world's adults with diabetes and 90% of untreated cases (WHO, 2024; Diabetes Atlas, 2026 & Duncan et al., 2025). In Bangladesh, diabetes cases increased from 1.8 million (2000) to ~13.9 million (2024) and are projected to >23 million by 2050, reflecting the ongoing nutritional and

epidemiological transition across South and Southeast Asia (Chowdhury et al., 2022; Eshita et al., 2026).

- **Predominance of Type 2 Diabetes:** T2D accounts for 90–95% of diabetes cases worldwide and is characterized by insulin resistance (T1D and gestational diabetes account for the remaining 5–10% of cases) (Type 1 and Type 2 Diabetes: Prevalence by Country, n.d.) and progressive β -cell dysfunction, largely driven by modifiable risk factors such as obesity, physical inactivity, and unhealthy diets (Diabetes Atlas, 2026 & Duncan et al., 2025).
- **Complications:** Beyond hyperglycemia, diabetes is a leading cause of blindness, kidney failure, heart attack, stroke, and amputation through microvascular (eyes, kidneys) and macrovascular (heart, major vessels) damage. In 2021, diabetes and related kidney disease caused >2 million deaths; by 2024, diabetes was linked to ~3.4 million deaths - roughly 1 every 9 seconds (WHO, 2024 & Duncan et al., 2025). These complications carry significant economic as well as human costs.

Non-Communicable Diseases in Bangladesh:

Bangladesh, like much of South Asia, is experiencing an epidemiological transition in which NCDs have replaced communicable diseases as the leading cause of death and disability (Chowdhury et al., 2022b & Iedcr_Nbph, 2025). NCDs, including CVD, cancer, diabetes, chronic respiratory disease, and kidney disease, account for ~71% of all deaths in Bangladesh, with nearly half occurring before the age of 70 (WHO, 2025 & WHO, 2026). This pattern reflects the broader burden of NCDs in LMICs, which experience the majority of premature NCDs-related deaths worldwide (Noncommunicable Diseases, Rehabilitation and Disability (NCD), 2022 & Rahman et al., 2022).

- **Scale of the NCDs Burden:** Bangladesh's NCDs burden mirrors the global pattern, with NCDs accounting for ~71% of all deaths, similar to the worldwide estimate of 41 million deaths annually (~71% of total deaths) (Noncommunicable Diseases, Rehabilitation and Disability (NCD), 2022 & Rahman et al., 2022). However, nearly half of NCDs deaths in Bangladesh occur prematurely, highlighting persistent gaps in early diagnosis, treatment, and risk-factor control (WHO, 2025; WHO, 2026 & Rahman et al., 2022). In 2025, Bangladesh and WHO launched a whole-of-

government initiative involving 35 ministries to strengthen NCDs prevention and control in response to their growing health and economic burden (WHO, 2025).

- **Major Contributors:**

1. **Diabetes:** Diabetes prevalence in Bangladesh has increased markedly, rising from about 11.0% in 2011 to 13.7% in 2017-2018, largely due to urbanization, dietary changes, and increasing overweight and obesity. As major NCDs, diabetes contributes substantially to mortality and increases the risk of CVDs and kidney diseases (Khan, M. N., et al. (2022) & Chowdhury et al., 2022).
2. **Cardiovascular Diseases:** CVDs are the leading cause of NCDs mortality globally, responsible for ~17.9 million deaths annually (31% of all deaths) (Eshita et al., 2026). In Bangladesh, CVDs risk has increased alongside a marked rise in hypertension prevalence, from 20% to 34% in men and from 32% to 45% in women between 2011 and 2017 (Hossain et al., 2024).
3. **Chronic Respiratory Diseases:** Chronic obstructive pulmonary disease (COPD) and asthma are major contributors to mortality and disability in Bangladesh (Iedcr_Nbph, 2025 & Rahman et al., 2022). > 90% of global COPD deaths occur in developing countries, largely due to air pollution, tobacco use, and occupational exposures that are common in LMICs such as Bangladesh (Iedcr_Nbph, 2025).
4. **Cancer:** This is a major cause of NCDs mortality in Bangladesh, driven by population ageing, tobacco use, and unhealthy diets, with limited screening and treatment capacity exacerbating its burden (Iedcr_Nbph, 2025 & Rahman et al., 2022).
5. **Kidney Diseases:** It is a major contributor to NCDs mortality in Bangladesh and is often a complication of poorly controlled diabetes and hypertension (WHO, 2025 & WHO, 2026). Globally, diabetes and diabetes-related kidney disease caused >2 million deaths in 2021, highlighting the close interrelationship among major NCDs (Kibria et al., 2024).

- **Implications:** Close interrelationship among major NCDs means that targeting shared risk factors, including obesity, insulin resistance, hypertension,

and unhealthy diets, could provide substantial public health benefits in Bangladesh.

Overweight and Obesity in Children and Adolescents in Bangladesh:

Bangladesh faces a double burden of malnutrition, with rising childhood and adolescent overweight and obesity alongside persistent undernutrition, particularly in urban areas (Tariqujjaman et al., 2022 & Rahman et al., 2014).

- **Overweight and Obesity among Children (6-12 Years):** A 2024 study of 365 Bangladeshi school children reported marked urban-rural disparities in overweight and obesity. Urban children had substantially higher rates of overweight (17.6% vs. 2.6%) and obesity (21.8% vs. 1.5%) than rural children (Islam et al., 2024). These findings are consistent with previous studies linking childhood obesity in urban Bangladesh to energy-dense diets, higher socioeconomic status, and sedentary lifestyles (Bulbul & Hoque, 2014 & Sarker, 2025).
- **Overweight and Obesity among Children (9-14 Years) in Dhaka City:** A high prevalence of overweight (36.0%) and obesity (25.3%) was reported among children in Dhaka, particularly in private schools. ~95% of overweight or obese children did not participate in household physical activities, highlighting sedentary behavior as a key contributor to the city's disproportionate childhood obesity burden (Islam et al., 2024 & Hossain et al., 2020).
- **Overweight and Obesity among Adolescents (15-19 Years):** A 2024 analysis of the nationally representative Bangladesh Adolescent Health and Wellbeing Survey (2019-2020) found a combined overweight/obesity prevalence of 10.6% among adolescents. Prevalence was higher among girls (11.6% vs. 8.3%), urban adolescents (15.7% vs. 9.2%), and those from wealthier households. Older age, higher school grade, and media exposure were also independently associated with overweight and obesity (Ahmed et al., 2024).
- **Implications:** Across all age groups, overweight and obesity are more common among Bangladeshi children and adolescents in urban and wealthier households and are associated with sedentary, media-oriented lifestyles (Islam et al., 2024; Hossain et al., 2020 & Ahmed et al., 2024). These trends reflect Bangladesh's double burden of malnutrition and rising NCDs risk, underscoring the need for early, school-based, and urban-focused obesity

prevention (Tariqujjaman et al., 2022; Rahman et al., 2014 & Ahmed et al., 2024).

Diabetes in Bangladesh:

Bangladesh has the 2nd-highest diabetes prevalence and the 2nd-largest number of adults living with diabetes in the IDF South-East Asia Region (Diabetes Atlas, 2025).

- **13.9 Million Adults Living with Diabetes:** In 2024, ~13.9 million Bangladeshi adults (20-79 years) were living with diabetes, up from 1.8 million in 2000 and 8.4 million in 2011. The IDF projects this number will increase to 23.1 million by 2050 without effective prevention. Additionally, 39.1% of adults with diabetes, ~5.4 million people, remain undiagnosed, highlighting a major gap in early detection and care (Diabetes Atlas, 2025 & Eshita et al., 2026).
- **Diabetes Prevalence (13.2%):** Age-standardized prevalence of diabetes among Bangladeshi adults increased from 10.5% in 2011 to 13.2% in 2024 and is projected to reach 15.4% by 2050. In addition, 17.1% of adults had impaired fasting glucose and 13.5% had impaired glucose tolerance in 2024, highlighting a large population at increased risk of developing diabetes (Diabetes Atlas, 2025 & Eshita et al., 2026).
- **Significantly Higher Urban Prevalence:** Diabetes prevalence is consistently higher in urban than rural areas in Bangladesh. The 2017-18 BDHS reported prevalence of 10.8% versus 7.4% (Talukder et al., 2024), while a separate analysis of same dataset found age-standardized rates of 11.8% versus 7.9% (Hossain et al., 2022). The WHO STEPS 2018 survey similarly reported raised blood glucose in 13.2% of urban adults compared with 7.1% of rural adults (Ahmed, 2025). A meta-analysis of 26 studies confirmed this pattern (11.5% vs 6.2%), identifying urbanization as a major driver of Bangladesh's growing diabetes burden, likely reflecting differences in diet, physical activity, and occupational patterns (Eshita et al., 2026 & Akhtar et al., 2020).
- **Implications:** Bangladesh is experiencing one of the fastest rises in diabetes, driven by urbanization and lifestyle changes. This highlights the need for accessible, non pharmacological interventions, including IF, in the national NCDs response (De Cabo & Mattson, 2019).

Physiology of Fasting:

During fasting, insulin decreases while counter-regulatory hormones (glucagon, cortisol, growth hormone, catecholamines) increase. The body uses stored fat, produces ketones, and preserves glucose for essential tissues (brain, RBCs, renal medulla), minimizing protein breakdown. Phases of fasting metabolism are:

1. Postabsorptive Phase (0-24 h)
2. Glycogen Depletion (24-48 h)
3. Increased Lipolysis & Fat Oxidation (2-3 days onward)
4. Ketogenesis (≥ 3 -4 days).

Physiological & Health Benefits of Metabolic Switching:

Metabolic Switching (glucose-to-ketone switch) is the adaptive shift from glucose/glycogen to fatty acids and ketone bodies as the primary energy source during fasting, CR, prolonged exercise, or carbohydrate restriction. It is a key feature of metabolic flexibility, enabling body to match fuel use to nutrient availability and promoting survival during periods of food scarcity. Physiological and Health Benefits are:

- **Improve Energy Efficiency:** During IF, fat provides a sustained energy source that preserves glycogen stores, while ketone bodies efficiently fuel the brain and heart, reducing the body's dependence on glucose.
- **Reduce Adiposity:** IF increases lipolysis and fatty acid oxidation, promoting the use of stored fat for energy and reducing body fat. TRE also decreases fat mass, with benefits that may extend beyond CR alone (Mattson et al., 2018; Anton et al., 2018).
- **Improve Insulin Sensitivity:** Repeated low-insulin periods during IF improve insulin sensitivity, reduce hepatic glucose production, and enhance tissue glucose uptake. β -hydroxybutyrate also acts as a signaling molecule that supports metabolic health and overall glucose regulation. (Mattson et al., 2017; Mattson, 2025).

Autophagy:

It is a highly conserved, lysosome-dependent cellular process that degrades and recycles damaged organelles, misfolded proteins, and other cytoplasmic components to maintain cellular homeostasis, especially during nutrient deprivation or cellular stress. Common types in mammalian cells are: Macroautophagy, Microautophagy and Chaperone-mediated autophagy. Potential implications include:

- **Neuroprotection:** Autophagy removes misfolded proteins linked to neurodegenerative diseases such

as Parkinson's and Alzheimer's. Its impairment accelerates disease progression, while enhanced autophagy shows neuroprotective effects in preclinical studies (Mattson et al., 2018; Mattson et al., 2017).

- **Improve Cardiac Function:** Autophagy preserves mitochondrial quality in cardiomyocytes. Impaired autophagy contributes to cardiac hypertrophy, heart failure, and ischemia-reperfusion injury, while its enhancement is cardioprotective in animal studies.
- **Reduce Hepatic Lipid Accumulation:** Autophagy promotes hepatic lipid turnover. Impaired autophagy is associated with hepatic steatosis, while autophagy induction reduces lipid accumulation in experimental models.
- **Improve Insulin Sensitivity:** Autophagy maintains pancreatic β -cell function and reduces cellular stress. Dysregulated autophagy contributes to β -cell dysfunction and the development of T2D.
- **Reduce Inflammation:** Autophagy removes damaged mitochondria, thereby reducing chronic low-grade inflammation.
- **Extend Lifespan:** Autophagy induced by CR, fasting, or agents such as rapamycin and spermidine extends lifespan in model organisms, whereas its genetic impairment abolishes these longevity benefits.

Effect of Intermittent Fasting on Hormones:

IF reshapes the endocrine system by altering hormone levels that drive metabolic adaptations. These changes regulate appetite, fuel use, energy expenditure, and processes such as metabolic switching and autophagy. Key hormonal changes are:

- **Insulin:** IF lowers fasting insulin levels and improves insulin sensitivity, promoting lipolysis and hepatic ketogenesis during fasting while enhancing insulin receptor responsiveness in muscle, liver, and adipose tissue. Improved insulin sensitivity is one of the most consistently reported metabolic benefits of IF (Mattson et al., 2017; Mattson, 2025).
- **Glucagon:** During fasting, glucagon secretion increases as the insulin-to-glucagon ratio declines, stimulating hepatic glycogenolysis, gluconeogenesis, lipolysis, and ketogenesis to maintain blood glucose and promote the metabolic shift toward fat oxidation (Mattson, 2025).
- **Cortisol:** Prolonged fasting modestly increases cortisol to support gluconeogenesis and fuel

mobilization. However, excessive fasting may sustain cortisol elevation, leading to adverse catabolic and metabolic effects (Endocrine Adaptations to Prolonged Fasting, 2025).

- **Growth Hormone:** IF and short-term fasting significantly increase growth hormone secretion, enhancing lipolysis, preserving lean body mass, and reducing glucose utilization to minimize protein breakdown during fasting (Intermittent Fasting: A Comprehensive Review, 2025).
- **Leptin:** Leptin levels decline during fasting, increasing appetite and reducing energy expenditure. Over time, IF improve leptin sensitivity, particularly in individuals with obesity (Mattson et al., 2017; Mattson, 2025).
- **Ghrelin:** With regular IF, ghrelin adapts to the fasting schedule, reducing hunger over time (Intermittent Fasting: A Comprehensive Review, 2025).
- **Integrated Effects on Appetite & Fat Metabolism:** During IF, reduced insulin and increased glucagon and growth hormone promote lipolysis, fatty acid oxidation, and ketogenesis. Over time, adaptations in ghrelin and leptin signaling may reduce hunger (Mattson et al., 2017; Mattson, 2025).

Weight Loss Benefits of Intermittent Fasting:

Studies show that IF effectively improves body weight and composition, with outcomes comparable to continuous calorie restriction (Harris et al., 2018; Moon et al., 2020; Varady et al., 2022).

- **Body Weight Reduction:** Systematic reviews show that IF reduces body weight by 3-8% over 8-12 weeks, with effects comparable to continuous CR (Harris et al., 2018; Moon et al., 2020; Welton et al., 2020).
- **Reduction in Body Mass Index (BMI):** IF consistently reduces BMI, with greater improvements in longer-term interventions (Moon et al., 2020; Welton et al., 2020).
- **Reduction in Waist Circumference:** IF reduces waist circumference, with greater improvements in longer-term interventions. Modified alternate-day fasting may produce the largest reductions (Moon et al., 2020; Varady et al., 2022).
- **Clinical Interpretation:** Evidence supports IF as an effective alternative to continuous CR for weight management, with additional benefits for visceral fat, lipid profiles, and fasting insulin. However, its effectiveness varies by fasting protocol, individual

characteristics, and intervention duration, highlighting the need for personalized approaches (De Cabo & Mattson, 2019; Moon et al., 2020).

Intermittent Fasting Reduces Fat Mass:

IF reduces fat mass, particularly visceral fat, while better preserving lean mass than continuous calorie restriction (De Cabo & Mattson, 2019; Anton et al., 2018). Key mechanisms include:

- **Metabolic Switch to Fat Burning:** Metabolic switching during IF shifts energy use from glucose to fatty acids and ketone bodies, promoting repeated lipolysis and fat oxidation that preferentially reduces body fat (Mattson et al., 2017; de Cabo & Mattson, 2019).
- **Enhanced Metabolic Flexibility and Browning of Fat:** Animal studies suggest intermittent fasting promotes white adipose tissue browning and increases fat oxidation, but these effects remain unconfirmed in humans (Li et al., 2017; de Cabo & Mattson, 2019).
- **Preferential Loss of Visceral Fat:** IF reduces visceral adipose tissue, particularly in overweight and obese individuals. Animal studies also suggest beneficial visceral fat remodeling (Varady et al., 2022; Moon et al., 2020).
- **Lower Abdominal Obesity:** IF consistently reduces waist circumference, reflecting decreased abdominal fat and potentially lowering cardiometabolic disease risk (Moon et al., 2020; Welton et al., 2020).
- **Clinical Interpretation:** IF consistently reduces visceral fat and improves body composition, although its superiority over continuous calorie restriction remains uncertain (De Cabo & Mattson, 2019; Varady et al., 2022).

Intermittent Fasting and Insulin Sensitivity:

IF improves insulin sensitivity by reducing fasting glucose, HbA1c, and fasting insulin, with accompanying decreases in body weight, BMI, and waist circumference. These benefits are likely driven by visceral fat reduction and improved insulin sensitivity (De Cabo & Mattson, 2019; Moon et al., 2020; Anton et al., 2018).

- **Interpreting the HbA1c and Glucose Findings:** Intermittent fasting consistently improves insulin sensitivity and reduces fasting insulin, while improvements in fasting glucose and HbA1c are generally modest (Moon et al., 2020; Welton et al., 2020).

- **Corroborating Evidence:** Recent reviews show that IF improves insulin sensitivity, lowers fasting insulin, and favorably affects body composition, blood lipid levels, and blood pressure. These metabolic benefits are generally greater in individuals with obesity, older adults, and those with higher baseline insulin resistance (De Cabo & Mattson, 2019; Moon et al., 2020; Anton et al., 2018).
- **Mechanistic Considerations:**
 1. **Reduced Visceral Adiposity:** Reducing pro-inflammatory adipokine and cytokine release from adipose tissue, thereby improving insulin sensitivity (de Cabo & Mattson, 2019).
 2. **Extended Fasting Periods:** Lowering basal insulin secretion and improving hepatic insulin sensitivity through fatty acid oxidation and ketogenesis (Mattson et al., 2017; de Cabo & Mattson, 2019).
 3. **Circadian Alignment:** Aligning eating windows with peak daytime insulin sensitivity (Sutton et al., 2018).

Cardiovascular Benefits of Intermittent Fasting:

IF improve cardiovascular health by reducing obesity, hypertension, dyslipidemia, and insulin resistance (de Cabo & Mattson, 2019; Cho et al., 2019; Varady et al., 2022).

- **Blood Pressure:** IF modestly lowers blood pressure by approximately 3-5 mmHg systolic and 2-4 mmHg diastolic, with modified alternate-day fasting showing the greatest benefit (Cho et al., 2019; Welton et al., 2020).
- **LDL Cholesterol:** IF lowers LDL cholesterol, although the magnitude of improvement varies widely depending on baseline lipid levels, fasting protocol, adherence, and intervention duration. Evidence suggests modest but consistent LDL reduction, particularly with periodic fasting (Cho et al., 2019; de Cabo & Mattson, 2019).
- **Triglycerides:** Longer-term intermittent fasting improves triglyceride levels and may modestly increase HDL cholesterol (Cho et al., 2019; Moon et al., 2020).
- **Mechanistic Considerations:**
 1. **Reduction in Visceral and Ectopic Fat** - lowers inflammation linked to hypertension and endothelial dysfunction.
 2. **Improved Endothelial Function** - enhances vascular reactivity and cardiovascular health.

3. **Sympathetic Nervous System Modulation** - reduced activity helps lower blood pressure in metabolic syndrome.
4. **Circadian Realignment** through time restricted eating, improving nocturnal blood pressure regulation.

Intermittent Fasting and Inflammation:

Data for anti-inflammatory effects of IF remains mixed:

- **TNF- α :** IF modestly reduces TNF- α , particularly in individuals with overweight or obesity (Cho et al., 2019; de Cabo & Mattson, 2019).
- **IL-6:** Evidence is inconsistent, with most studies showing no significant effect of IF on IL-6 (Faris et al., 2020; Cho et al., 2019).
- **CRP:** CRP reduction with IF appears to depend mainly on weight loss rather than fasting itself (Cho et al., 2019; Welton et al., 2020).
- **Relevance to Cardiovascular Disease Prevention:** Inflammation is a key driver of CVDs, and IF may reduce inflammatory markers, particularly through weight loss (de Cabo & Mattson, 2019).
- **Interpreting the Mixed Evidence:** IF modestly reduce TNF- α and CRP, with most anti-inflammatory benefits likely driven by weight loss (Cho et al., 2019; Anton et al., 2018).

Impact of Intermittent Fasting on Brain Health:

IF support brain health through neuroprotective mechanisms, although evidence is stronger in animal than human studies (Mattson et al., 2018; de Cabo & Mattson, 2019).

- **Cognitive Enhancement:** Emerging evidence suggests IF may improve executive function and memory, particularly in older adults with insulin resistance, although evidence remains inconsistent (Mattson et al., 2018; de Cabo & Mattson, 2019).
- **Motor Performance:** Animal studies suggest IF may improve Parkinson's disease but human evidence remains limited (Mattson et al., 2018; Longo & Mattson, 2014).
- **Neuroprotective Effects:** Preclinical studies suggest IF may protect against neurological disorders by enhancing autophagy, reducing protein aggregation, improving neuronal plasticity, and modulating immune and gut microbiota functions. However, human clinical evidence remains limited (Mattson et al., 2018; de Cabo & Mattson, 2019).

Intermittent Fasting and Public Health Advantages:

As NCDs increasingly burden global health, especially in resource limited settings, IF has emerged as a promising public health strategy due to its potential health benefits, low cost, and ease of implementation compared with pharmacological or highly structured dietary interventions (de Cabo & Mattson, 2019; WHO, 2023).

- **Easy Implementation and Adaptability:** IF is simple to implement, requiring no specialized foods or calorie tracking. Its flexible, time-based approach is adaptable across populations and can be delivered through low-cost digital platforms, although long-term adherence requires further study (Anton et al., 2018; de Cabo & Mattson, 2019).
- **Low-Cost Intervention:** IF is a low-cost, non-pharmacological intervention requiring no medications, specialized foods, or intensive monitoring, making it especially valuable for reducing NCDs burden in resource-limited LMICs. (de Cabo & Mattson, 2019; WHO, 2023).
- **Decreasing the NCDs Burden:** Current evidence suggests IF may reduce NCDs burden by improving metabolic health, cardiovascular risk factors, and cellular stress responses. However, further research is needed to authenticate its long-term effectiveness (de Cabo & Mattson, 2019; Mattson et al., 2017; Anton et al., 2018).
- **Enhancing Longevity:** Studies associate periodic fasting with better survival and fewer cardiovascular events, but causality remains unproven. Current evidence supports benefits for health span more than life span.

Public Health Outcomes of Ramadan Fasting:

- **Historical and Conceptual Background:** Scientific interest in Ramadan fasting expanded after the 1994 International Congress on Health and Ramadan. Its annual observance by ~2 billion people provides a unique natural model for studying the health effects of prolonged diurnal fasting across diverse populations (Trepanowski & Bloomer, 2010; Lessan & Ali, 2019; Faris et al., 2020).
- **Dietary Diversity, Nutrient Intake, and Public Familiarity:** Ramadan fasting centers food intake around two meals, Sahri and Iftar, which often increase dietary variety and nutrient intake during non-fasting hours despite prolonged daytime fasting. Its widespread cultural familiarity reduces barriers to time restricted eating, making Ramadan a valuable model for studying and implementing IF

interventions (Lessan & Ali, 2019; Jahrami et al., 2021).

- **Psychological, Social, and Community Dimensions:** Beyond metabolic effects, Ramadan fasting may improve psychological well-being, self-discipline, and mindfulness while strengthening family and social cohesion through shared meals and charitable practices (Roky et al., 2004; Lessan & Ali, 2019).
- **Metabolic Outcomes:** Meta analyses show that Ramadan fasting produces modest, temporary weight loss, particularly in people with overweight or obesity, with most benefits reversing after Ramadan without sustained lifestyle changes (Sadeghirad et al., 2014; Fernando et al., 2019).
- **Immune Function and Oxidative Stress:** Systematic reviews suggest Ramadan fasting may modestly improve oxidative stress and cardiometabolic markers, including waist circumference, blood pressure, triglycerides, and HDL cholesterol. However, evidence for immune benefits remains inconclusive (Faris et al., 2020; Jahrami et al., 2021).

Ramadan Fasting in Bangladesh - Public Health Perspectives:

Bangladesh, where >90% of the population is Muslim, provides an important setting for studying Ramadan fasting in people with T2D. In EPIDIAR study, 89.8% of Bangladeshi patients with T2D fasted for at least 15 days during Ramadan. National studies, including Ramadan Perspective Epidemiology and Education in Diabetes (RAPEED) and DAR-BAN, show that many patients fast despite elevated clinical risk, often with limited glucose monitoring. However, structured pre-Ramadan counseling, risk stratification, and medication adjustment have been associated with low rates of fasting related complications (Hassanein et al., 2017; Ahmedani et al., 2022; IDF-DAR Guidelines, 2024). These findings highlight the need for evidence-based, locally tailored guidance to support safe Ramadan fasting and effective diabetes management.

Nutritional Risks of Intermittent Fasting:

- **Micronutrient Deficiencies:** IF may increase the risk of inadequate intake of micronutrients such as calcium, magnesium, potassium, folate, vitamin C, and B vitamins, primarily because people consume fewer calories and less nutrient dense food (de Cabo & Mattson, 2019; Anton et al., 2018).
- **Hypoglycemia:** It is one of the most important risks

of IF, especially for people taking insulin or sulfonylureas. Although medication adjustment and medical supervision can substantially reduce this risk, it is not eliminated, and IF is generally not recommended for people with T1D because of the added risk of severe hypoglycemia and diabetic ketoacidosis (IDF-DAR Guidelines, 2024; Davies et al., 2022).

- **Electrolyte Flux and Hypophosphatemia:** Fasting may increase urinary losses of sodium, potassium, magnesium, and calcium, particularly during the first few days, though changes are usually mild with time restricted eating. In contrast, prolonged fasting increases the risk of electrolyte disturbances, including refeeding syndrome, especially in malnourished, underweight, or recently weight lost individuals (de Cabo & Mattson, 2019; Longo & Mattson, 2014).
- **Protein Deficiency:** Prolonged or frequent IF can make it harder to meet protein needs within a limited eating window, increasing the risk of protein malnutrition if protein intake is not prioritized. Long term fasting may also contribute to vitamin and mineral deficiencies (Anton et al., 2018; de Cabo & Mattson, 2019).
- **Dehydration:** IF may increase risk of dehydration and hypotension, particularly in individuals take diuretics, SGLT2 inhibitors, or antihypertensive medications. This risk is greatest during Ramadan style fasting, where both food and water are restricted, unlike most IF regimens that permit water and noncaloric beverages (Lessan & Ali, 2019; IDF-DAR Guidelines, 2024).
- **Amenorrhea and Reproductive Effects:** Women may be more sensitive to IF, as prolonged energy restriction can disrupt reproductive hormones, causing menstrual irregularities, anovulation, and reduced fertility. These risks appear greatest with prolonged or restrictive fasting, especially when combined with low body fat, intensive exercise, or additional calorie restriction (Lowe et al., 2020; Templeman et al., 2021).
- **Poor Diet Quality and Other Considerations:** A key limitation of IF is its focus on meal timing rather than diet quality, which may encourage nutrient poor food choices and reduce its benefits. Common side effects include headaches, lethargy, constipation, dizziness, sleep disturbances, irritability, and disordered eating, particularly during

the initial adaptation period (de Cabo & Mattson, 2019; Templeman et al., 2021).

Intermittent Fasting and Risks for Women:

- **Menstrual Cycle Irregularities and Fertility:** IF may disrupt the hypothalamic-pituitary-gonadal axis when energy intake is insufficient, potentially causing menstrual irregularities and reduced ovulation. Women trying to conceive or with low body fat or irregular cycles should use IF with caution (Templeman et al., 2021; Lowe et al., 2020).
- **Blood Sugar Fluctuations:** IF may cause hypoglycemia in individuals use glucose-lowering medications. Its safety during pregnancy remains uncertain (American Diabetes Association, 2025; IDF-DAR Guidelines, 2024).
- **Nutrient Deficiencies:** IF may increase the risk of inadequate calcium, magnesium, potassium, folate, and B vitamin intake. This is particularly important for women of reproductive age, as calcium supports bone health and folate is essential before and during pregnancy (Anton et al., 2018; de Cabo & Mattson, 2019).
- **Loss of Lean Muscle Mass:** Weight loss with IF includes both fat and lean mass. Adequate protein intake and resistance exercise help preserve muscle mass (Varady et al., 2022; Anton et al., 2018).
- **Bone Mineral Density Reduction:** Evidence on IF and bone health is mixed. Adequate protein, calcium intake, and resistance exercise may help preserve bone and muscle mass (Lowe et al., 2020; Templeman et al., 2021).
- **Increased Stress and Mood Changes:** IF may increase cortisol, and women may be more sensitive to calorie restriction. Fasting tolerance may also vary across the menstrual cycle (Templeman et al., 2021; Lowe et al., 2020).
- **Sleep Disturbances:** Evidence suggests IF has mixed effects on sleep, with outcomes varying by fasting method and population (Jahrami et al., 2021; de Cabo & Mattson, 2019).
- **Potential Harm During Pregnancy and Breastfeeding:** IF is not recommended during pregnancy or breastfeeding because its safety is uncertain. During breastfeeding, it may reduce milk secretion (American College of Obstetricians and Gynecologists, 2023; IDF-DAR Guidelines, 2024).

World Health Organization and Intermittent Fasting:

The WHO recognizes IF as a potential aid for weight and metabolic health but recommends it only as part of a safe, balanced diet rather than a replacement for healthy long term eating habits (Admin, n.d.).

Centers for Disease Control and Prevention (CDC) and Intermittent Fasting:

The CDC neither endorses nor opposes IF, instead emphasizing balanced nutrition, portion control, and overall healthy eating rather than specific meal timing (Obesity, 2025).

Who should Avoid Intermittent Fasting?

- Pregnant women
- Lactating mother
- Children and teens <18
- Patients with Eating disorders
- Patients with type 1 diabetes
- Underweight individuals
- People with high Nutritional needs
- Individuals on specific Medications (e.g., Heart, Kidney, Liver disease)
- Frail Elderly adults, etc.

Safe Practices While Intermittent Fasting:

- **Hydration:** Prioritize water intake during fasting to prevent dehydration (ClinicalTrials.gov, n.d.).
- **Zero-Calorie Beverages:** Black coffee and unsweetened tea support satiety without breaking the fast (Grajower & Horne, 2019).
- **Dietary Framework:** A Pesco-Mediterranean diet complements time-restricted eating, with the 16:8 regimens being the most common approach (O'Keefe et al., 2020).
- **Nutrient Density:** Prioritize nutrient-dense foods to prevent micronutrient deficiencies during compressed eating windows (Wallerer & Schwingshackl, 2025).
- **Avoiding Poor Food Choices:** Resist compensating with calorie-dense, nutrient-poor foods, which can reverse metabolic benefits (Grajower & Horne, 2019).
- **Avoiding Overeating After Fasting:** Reintroduce food gradually to prevent glycemic spikes and digestive discomfort, especially after longer fasts (Grajower & Horne, 2019).
- **Symptom Monitoring:** Monitor for dizziness, fatigue, palpitations, or menstrual irregularities. Adjust fasting and seek medical advice if symptoms

occur.

NCDs, Intermittent Fasting and SDGs:

- **SDG 1 - No Poverty:** The economic burden of NCDs in Bangladesh undermines SDG 1. Catastrophic health expenditure affects about one quarter of households, pushing millions into poverty, with chronic illness as a major driver.
- **SDG 2 - Zero Hunger:** The nutritional aspects of IF align with SDG target 2.2. Balanced, diverse diets during fasting support adequate nutrition, while poorly implemented fasting may increase nutrient deficiencies, especially among adolescent girls, pregnant and lactating women, and older adults.
- **SDG 3 - Good Health and Well-Being:** SDG target 3.4 is the focus of this paper. Bangladesh remains off track to reduce premature NCDs mortality by 2030, highlighting the need for scalable, low cost strategies such as IF. Its benefits on insulin sensitivity, cardiovascular risk factors, and inflammation target key NCDs pathways.
- **SDG 5 - Gender Equality:** The paper's discussion of IF-specific risks for women aligns with SDG target 5.6. Incorporating sex specific considerations into national IF guidelines could strengthen gender responsive NCDs prevention in Bangladesh.
- **SDG 10 - Reduced Inequalities:** By emphasizing affordable, locally sourced diets and implementation across urban and rural settings, the paper supports SDG targets 10.2 and 10.3 by promoting equitable access to NCDs prevention regardless of income or location.
- **SDG 17 - Partnerships for the Goals:** The paper's call for multisectoral pilot studies aligns with SDG target 17.17 by emphasizing that effective NCDs prevention requires coordinated partnerships beyond the health sector.

Recommendations:

- Integrate IF into existing NCDs screening and lifestyle counseling
- Establish clear contraindications and medical screening protocols
- Develop religiously and culturally tailored national guidelines
- Pair IF with affordable, locally sourced dietary guidance
- Promote healthy diets more broadly
- Encourage evidence-based fasting approaches

- Launch multi-sector pilot studies in urban and rural communities
- Strengthen NCDs surveillance and research infrastructure
- Address gender-specific implementation gaps
- Build financial risk protection alongside behavioral guidance.

Conclusion:

Intermittent fasting is a promising, low-cost strategy for reducing NCDs risk, with evidence supporting improvements in insulin sensitivity, blood pressure, lipid profiles, and body weight. Its cultural acceptability and affordability make it particularly relevant for Bangladesh, where Ramadan fasting is widespread and the NCDs burden is increasing. However, IF is not superior to conventional CR, evidence for some long-term outcomes remains limited, and it may pose risks for vulnerable groups.

Overall, IF should be viewed as a complementary component of comprehensive NCDs prevention rather than a standalone solution. Its successful implementation requires integration into primary healthcare, culturally appropriate national guidelines, balanced nutrition, individualized medical screening, and continued research to strengthen the evidence base.

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