Hormonal Adaptations to Intermittent Fasting Among Healthy Adults: A Prospective Interventional Study

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Abstract

Background

Intermittent fasting (IF) has gained significant attention as a dietary intervention capable of improving metabolic health. The physiological benefits of IF are largely mediated through endocrine adaptations that regulate energy metabolism, appetite, and substrate utilization. **Objective** To investigate the hormonal adaptations associated with an 8-week intermittent fasting intervention among healthy adults.

Methods

A prospective interventional study was conducted on 60 healthy adults aged 20–40 years. Participants followed a 16:8 time-restricted feeding protocol for eight weeks. Fasting blood samples were collected at baseline and post-intervention to assess serum insulin, glucagon, growth hormone (GH), cortisol, leptin, ghrelin, and adiponectin levels. Anthropometric measurements and metabolic parameters were also recorded. Data were analyzed using paired t-tests, with $p < 0.05$ considered statistically significant.

Results

After 8 weeks of intermittent fasting, significant reductions were observed in insulin levels (18.4 ± 3.2 to 11.1 ± 2.5 µIU/mL, $p<0.001$) and leptin levels (16.3 ± 4.1 to 11.8 ± 3.5 ng/mL, $p<0.001$). Growth hormone increased significantly from 2.6 ± 1.1 to 5.7 ± 1.8 ng/mL ($p<0.001$). Glucagon and adiponectin levels increased significantly, whereas cortisol showed a mild non-significant increase.

Conclusion

Intermittent fasting induces favorable hormonal adaptations characterized by improved insulin sensitivity, enhanced lipolysis, and better metabolic flexibility. These findings support the role of intermittent fasting as a potential strategy for improving endocrine and metabolic health.

Keywords: Intermittent fasting, hormones, insulin, glucagon, growth hormone, leptin, metabolic adaptation

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Introduction

Intermittent fasting (IF) is a dietary approach characterized by alternating periods of eating and fasting. Unlike traditional calorie restriction, IF primarily focuses on meal timing and eating windows rather than continuous caloric reduction. Common forms include alternate-day fasting, the 5:2 diet, and time-restricted feeding (TRF), with the 16:8 regimen being among the most widely practiced methods (1).

Human physiology evolved under conditions where periods of food scarcity were common. Consequently, metabolic pathways developed mechanisms to adapt to temporary nutrient deprivation. During fasting, the body transitions from glucose-dependent metabolism to increased utilization of fatty acids and ketone bodies, a process commonly referred to as the metabolic switch (2). This transition is orchestrated by a series of hormonal adaptations that optimize energy utilization and maintain homeostasis.

Insulin plays a central role in nutrient storage and glucose regulation. Following food intake, insulin promotes glucose uptake and inhibits lipolysis. During fasting, insulin secretion decreases substantially, allowing stored triglycerides to be mobilized for energy production (3). Reduced insulin concentrations also enhance insulin sensitivity, a key factor in preventing insulin resistance and type 2 diabetes mellitus.

Glucagon acts antagonistically to insulin and increases during fasting. Elevated glucagon stimulates glycogenolysis and gluconeogenesis, ensuring maintenance of blood glucose levels despite prolonged periods without food intake (4). Together, these hormonal changes facilitate metabolic adaptation and energy balance.

Growth hormone (GH) is another critical endocrine regulator affected by fasting. Previous investigations have demonstrated substantial increases in GH secretion during fasting periods. Increased GH promotes lipolysis while preserving lean body mass, thereby supporting survival during periods of caloric deprivation (5). Similarly, cortisol contributes to glucose homeostasis by promoting hepatic glucose production and facilitating adaptation to fasting-related physiological stress (6).

Appetite regulation during fasting is largely governed by leptin and ghrelin. Leptin, secreted by adipose tissue, signals energy sufficiency and decreases during fasting, whereas ghrelin, produced primarily in the stomach, stimulates hunger and meal initiation (7). Repeated fasting exposure appears to improve appetite regulation through adaptations in these hormonal pathways.

Recent studies have also highlighted the role of adiponectin, an adipocyte-derived hormone associated with insulin sensitivity and anti-inflammatory effects. Increased adiponectin levels during fasting may contribute to improved metabolic health and reduced cardiovascular risk (8).

Although numerous studies have documented the metabolic benefits of intermittent fasting, limited data are available regarding the collective hormonal adaptations occurring during structured fasting interventions. Therefore, the present study aimed to evaluate endocrine changes following an 8-week intermittent fasting program among healthy adults.

Materials and Methods

A prospective interventional study was conducted over eight weeks in the Department of Physiology of a university-affiliated research center.

Study Population

Sixty healthy volunteers (30 males and 30 females) aged between 20 and 40 years were recruited through convenience sampling.

Inclusion Criteria

- Healthy adults aged 20–40 years.
- BMI between 18.5 and 29.9 kg/m².
- No chronic metabolic disorders.
- Willingness to adhere to fasting protocol.

Exclusion Criteria

- Diabetes mellitus.
- Pregnancy or lactation.
- Endocrine disorders.
- Current medication affecting hormonal function.
- Smoking or alcohol abuse.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment.

Intervention

Participants followed a 16:8 intermittent fasting schedule for 8 weeks. Food consumption was restricted to an 8-hour window (12:00 PM–8:00 PM), followed by a 16-hour fasting period.

Data Collection

Anthropometric measurements included:

- Height
- Weight
- Body Mass Index (BMI)
- Waist circumference

Venous blood samples were collected following an overnight fast at baseline and after 8 weeks.

Biochemical Analysis

The following hormones were analyzed using ELISA kits:

- Insulin

- Glucagon
- Growth Hormone
- Cortisol
- Leptin
- Ghrelin
- Adiponectin

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation. Paired t-tests were used to compare baseline and post-intervention values. Statistical significance was established at $p < 0.05$.

Results

Table 1. Baseline Characteristics of Participants (n = 60)

Variable	Mean ± SD
Age (years)	29.6 ± 5.8
Weight (kg)	76.2 ± 10.4
BMI (kg/m²)	27.1 ± 2.9
Waist Circumference (cm)	92.8 ± 8.5

Participants were predominantly overweight adults with no major health conditions. Baseline characteristics were comparable across both sexes.

Table 2. Hormonal Changes Following 8 Weeks of Intermittent Fasting

Hormone	Baseline	Week 8	p-value
Insulin (μIU/mL)	18.4 ± 3.2	11.1 ± 2.5	<0.001
Glucagon (pg/mL)	72.3 ± 8.5	88.7 ± 10.2	<0.001
Growth Hormone (ng/mL)	2.6 ± 1.1	5.7 ± 1.8	<0.001
Cortisol (μg/dL)	14.2 ± 2.7	15.1 ± 2.8	0.082
Leptin (ng/mL)	16.3 ± 4.1	11.8 ± 3.5	<0.001
Ghrelin (pg/mL)	685 ± 94	742 ± 101	0.021
Adiponectin (μg/mL)	6.2 ± 1.3	8.9 ± 1.7	<0.001

Significant hormonal adaptations occurred following intermittent fasting. Insulin and leptin levels decreased substantially, whereas glucagon, growth hormone, ghrelin, and adiponectin increased significantly.

Table 3. Metabolic Outcomes

Parameter	Baseline	Week 8	p-value
Body Weight (kg)	76.2 ± 10.4	72.8 ± 9.8	<0.001
BMI (kg/m²)	27.1 ± 2.9	25.9 ± 2.8	<0.001
Fasting Glucose (mg/dL)	96.8 ± 8.4	89.2 ± 6.5	<0.001

Improvements in body composition and glycemic control accompanied the observed endocrine adaptations.

Discussion

The present study investigated hormonal responses to an 8-week intermittent fasting intervention. The findings demonstrate substantial endocrine adaptations that support improved metabolic regulation and energy utilization.

A significant reduction in insulin levels was observed following the fasting intervention. This finding is consistent with previous studies reporting enhanced insulin sensitivity and reduced insulin resistance after intermittent fasting (9). Lower insulin concentrations facilitate lipolysis and increase reliance on stored fat as a primary energy source.

The observed increase in glucagon levels supports the concept of metabolic switching during fasting. Glucagon stimulates hepatic glucose production and mobilization of energy stores, ensuring maintenance of glucose homeostasis (10). Increased glucagon together with reduced insulin promotes fatty acid oxidation and ketogenesis.

Growth hormone concentrations increased more than twofold following the intervention. Similar findings were reported by Ho et al., who demonstrated enhanced pulsatile growth hormone secretion during fasting states (5). Elevated GH contributes to preservation of lean body mass while promoting mobilization of adipose tissue triglycerides.

Leptin levels decreased significantly after fasting. Since leptin secretion is proportional to adipose tissue mass and energy availability, reductions in leptin are expected during caloric restriction and fasting (7). Although lower leptin levels may theoretically increase hunger, participants reported improved appetite control over time, suggesting adaptive changes in appetite-regulating pathways.

Ghrelin levels increased modestly but remained within physiological limits. Previous investigations have shown that ghrelin exhibits circadian fluctuations and adapts to meal timing patterns (11). The modest increase observed in the present study likely reflects physiological adaptation to prolonged fasting intervals.

Adiponectin concentrations increased significantly after the intervention. Adiponectin is recognized for its insulin-sensitizing and anti-inflammatory properties (12). Elevated adiponectin may contribute to the improved glucose regulation and metabolic health observed among fasting individuals.

Cortisol levels exhibited a mild increase that did not reach statistical significance. This finding suggests that intermittent fasting induces adaptive

physiological stress without causing excessive activation of the hypothalamic-pituitary-adrenal axis. Similar observations have been reported in healthy fasting populations (13).

Overall, the hormonal changes documented in this study demonstrate a coordinated endocrine response that promotes metabolic flexibility, improved energy utilization, and enhanced metabolic health. These adaptations likely explain many of the beneficial effects associated with intermittent fasting.

Conclusion

Eight weeks of intermittent fasting produced significant hormonal adaptations characterized by decreased insulin and leptin levels and increased glucagon, growth hormone, ghrelin, and adiponectin concentrations. These endocrine changes were accompanied by improvements in body weight, BMI, and fasting glucose levels. Intermittent fasting appears to be an effective non-pharmacological strategy for improving metabolic and hormonal health in healthy adults.

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