

Intermittent fasting dissociates beneficial effects of dietary restriction on glucose metabolism and neuronal resistance to injury from calorie intake

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Dietary restriction has been shown to have several health benefits including increased insulin sensitivity, stress resistance, reduced morbidity, and increased life span. The mechanism remains unknown, but the need for a long-term reduction in caloric intake to achieve these benefits has been assumed. We report that when C57BL/6 mice are maintained on an intermittent fasting (alternate-day fasting) dietary restriction regimen their overall food intake is not decreased and their body weight is maintained. Nevertheless, intermittent fasting resulted in beneficial effects that met or exceeded those of caloric restriction including reduced serum glucose and insulin levels and increased resistance of neurons in the brain to excitotoxic stress. Intermittent fasting therefore has beneficial effects on glucose regulation and neuronal resistance to injury in these mice that are independent of caloric intake.

caloric restriction | hippocampus | insulin | β -hydroxybutyrate | ketosis

Aging refers to the biological changes that occur during a lifetime that result in reduced resistance to stress, increased vulnerability to disease, and an increased probability of death. The rate at which aging occurs is species-specific, suggesting a strong genetic influence. The only environmental variable that has been shown to markedly affect the rate of aging in a wide range of species is caloric intake. Restricting food intake to a level below that which would be consumed voluntarily results in a decrease in the rate of aging and an increase in average and maximum life span (1, 2). Dietary restriction (DR) reduces cancer formation (3, 4) and kidney disease (5) and increases the resistance of neurons to dysfunction and degeneration in experimental models of Alzheimer's and Parkinson's diseases as well as stroke (6–9). Two different DR paradigms have proven effective in increasing life span and disease resistance in rats and mice. In one paradigm animals are provided a daily food allotment that is typically 30–40% less than the ad libitum (A.L.) consumption of a control population; this limited daily feeding (LDF) paradigm involves a controlled caloric restriction and a corresponding reduction in body weight. In the second paradigm animals are subjected to intermittent (alternate-day) fasting (IF), which in rats results in reduced food intake over time and decreased body weight (10).

Restricting caloric intake causes the restricted population to weigh proportionally less than the A.L.-fed group. Indeed, weight reduction typically slightly exceeds the degree of food restriction, so that food intake per gram of body weight is reported consistently to be slightly higher in LDF animals than in their A.L.-fed counterparts (11). Rats and mice usually lose weight when maintained on an IF regimen, although some strains such as C57BL/6 mice may lose little or no weight (12). Both the IF and LDF paradigms are reported to result in dramatic increases in life span in comparison to A.L.-fed animals (13), but little else is known concerning the similarities and differences in their effects.

It seems reasonable to assume that both LDF and IF paradigms of DR extend life span through a common mechanism. To gain insight into the nature of the underlying mechanism, we compared the effects of LDF and IF diets on several parameters that have been postulated to play a role in the protective effects of DR including body weight, food intake, and fasting levels of serum insulin, glucose, and insulin-like growth factor 1 (IGF-1). In addition, recent studies have shown that rats and mice maintained on an IF regimen exhibit increased resistance of neurons in their brains to insults relevant to the pathogenesis of several different human neurological disorders including epileptic seizures and stroke (6, 8, 14). We therefore performed an experiment to determine whether LDF and IF diets exert similar beneficial effects on neurons in the brain.

Materials and Methods

Animals and Measurements of Body Weight and Food Intake. Six-week-old C57BL/6 mice were obtained from Charles River Breeding Laboratories, housed in the National Institute on Aging Gerontology Research Center animal colony, and fed a standard NIH-07 diet (Harlan-Teklad, Indianapolis). Food was provided A.L. until 9 weeks of age. At that time, mice were assigned to one of three groups: A.L., fed ad libitum; IF, provided access to food every other day; and LDF, provided with a limited daily food allotment of 60% of that eaten by the A.L.-fed animals. To control for caloric intake versus periodic food deprivation, a fourth group was added. These pair-fed (PF) mice were provided daily with a food allotment equal to the average daily intake of mice in the IF group. Water was available A.L. for all groups. The animals were kept in a 12-h light/12-h dark cycle (lights on at 6 a.m. and off at 6 p.m.); food was provided or removed at 10 a.m. Body weight was determined each week on the same day and time. Food intake was measured daily. To keep track of spillage, white bedding was used to allow easy separation of unconsumed food and powder from waste and bedding; spilled food was allowed to dry fully to avoid measurement of wet weight added by urine. Statistical comparisons were made by using ANOVA. All procedures were approved by the National Institute on Aging Gerontology Research Center Animal Care and Use Committee.

Blood Collection and Analyses. At 29 weeks of age, all mice were fasted for 14 h before blood withdrawal. Blood was removed via intracardiac bleed under isoflurane anesthesia, and serum was

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Pathology and Intervention in Musculoskeletal Rehabilitation David J. Magee, James E. Zachazewski, William S. Quillen, Robert C. Manske, 2015-11-20 Design and implement a rehab program on your own with Pathology and Intervention in Musculoskeletal Rehabilitation 2nd Edition Part of Magee's popular Musculoskeletal Rehabilitation Series this pathology text for physical therapists provides clear guidance on patient management relative to specific musculoskeletal pathology injury and illness all based on a sound understanding of basic science and principles of practice It focuses on the specific pathologies most often seen in the clinic and discusses the best methods for intervention for the different areas of the body in the context of the tissue healing model Each intervention features a rationale along with the pathology and problem presented stage of healing evidence in the literature and clinical reasoning considerations Dedicated and focused information on the specific pathologies most often seen in the clinic as well as the best methods for intervention for the different areas of the body minimizes duplication of information by referring you to other titles in the Musculoskeletal Rehabilitation Series for basic scientific information regarding inflammation healing tissue deformation and the development of muscular strength and endurance Trusted experts in musculoskeletal rehabilitation along with internationally recognized contributors present the best evidence behind contemporary interventions directed toward the treatment of the impairments and functional limitations associated with acute chronic and congenital musculoskeletal conditions occurring across the lifespan Evidence based content with over 4 000 references supports the scientific principles for rehabilitation interventions providing the best evidence for the management of musculoskeletal pathology and injury NEW The Skin and Wound Healing chapter looks at the numerous tools available to assist in objectively monitoring and treating a patient with an acute or chronic wound NEW Rotator Cuff Pathology chapter highlights the anatomy function and etiology of the rotary cuff and addresses rotary cuff injuries physical examination and non operative and operative treatment UPDATED Substantially revised chapter on the Thoracic Ring ApproachT facilitates clinical reasoning for the treatment of the thoracic spine and ribs through the assessment and treatment of thoracic spine disorders and how they relate to the whole kinetic chain UPDATED Revised Lumbar Spine Treatment of Motor Control Disorders chapter explores some of the research evidence and clinical reasoning pertaining to instability of the lumbar spine so you can better organize your knowledge for immediate use in the clinical setting UPDATED Significantly revised chapter on the treatment of pelvic pain and dysfunction presents an overview of specific pathologies pertaining to the various systems of the pelvis and highlights how The Integrated Systems Model for Disability and Pain facilitates evidence based management of the often complex patient with pelvic pain and dysfunction NEW Musculoskeletal Bone and Soft Tissue Tumors chapter covers common bones tumors anatomic considerations and rehabilitation pediatric patients and amputation related to cancer UPDATED Thoroughly revised chapters with additional references ensure you get the most recent evidence and information available NEW Full color design and illustration

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viel natürlichem Fett den Körper an Fett zu verbrennen. Hier liegt das Geheimnis ketogener Ernährung. Mit gesunden Fetten und einer stark reduzierten Aufnahme von Kohlenhydraten beginnt der Körper Fett zu verbrennen, was zu Gewichtsreduktion und einem Lebensgefühl voller Energie führt, ohne hungern oder sich schwach fühlen zu müssen. Die Keto-Diät ruht auf dem Irrglauben, dass es eine Universallösung für alle gibt und zeigt einen flexiblen Ansatz, auf der auf die persönlichen Bedürfnisse eines jeden angepasst werden kann. Leanne Vogel ermutigt den Leser, einen individuellen Ernährungsplan zu entwickeln, indem sie sich auf die vielfältigen Möglichkeiten konzentriert, statt auf Einschränkungen traditioneller ketogener Ernährungspläne. Mit dem Hauptaugenmerk auf praxistauglichen Strategien und leckeren Rezepten kann jeder den Übergang zur ketogenen Ernährung schaffen und sie auch nachhaltig beibehalten.

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