

# Invited Article

## The Case for Semi-Starvation

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The eating disorder field has been slow to respond to the phenomenon of caloric restriction for longevity (CRL), currently a central focus of research in biogerontology. On the basis of compelling evidence that animals remain healthier and live longer on diets of 'anorexic' severity, some experts are recommending chronic self-deprivation to the general public. This brief article introduces a series of papers on CRL, outlining the challenges and opportunities the movement presents to our speciality area. Copyright © 2004 John Wiley & Sons, Ltd and Eating Disorders Association.

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To eating disorder (ED) specialists, severe caloric restriction (CR) is a symptomatic behaviour. When sustained for years, it imposes grave consequences on the few troubled people who persist. Individuals with anorexia nervosa (AN) often insist that they are 'healthy', but experts know that they are mistaken—indeed, only through increased eating and weight can they regain their health and begin to improve their lives.

To a growing number of physiologists and gerontologists, severe CR is a miraculous paradigm and a desirable goal. If practised for decades, it promises extraordinary benefits to anyone with the wisdom and self-discipline to persevere. The general public may doubt that one can be 'healthy' while eating too little to support normal physiology and reproduction. Confidently, experts assure them that they are mistaken—indeed, only through chronic under-eating can they hope to retain their health and vigour to the end of an unprecedented lifespan.

Which of these perspectives has the right take on the merits of radical restraint? The short answer is 'both of the above'. For more than half a century, separate lines of research have built strong empirical support for each position. Readers of this speciality

journal will be familiar with the case against extreme CR.<sup>1</sup> As clinicians, we plead it daily to our anorexic patients; as researchers, we add more evidence to the file with every investigation. Yet as a field, we have remained surprisingly ignorant of the opposing brief on behalf of semi-starvation. According to scientists who study caloric restriction for longevity (CRL), individuals with AN are basically on the right track for the wrong reason. When drastic caloric cutbacks are imposed on laboratory animals, species ranging from flies and fish to mice and monkeys all thrive (at least physically) on nutrient-dense deprivation (Masoro, 1988; Roberts et al., 2001; Roth, Ingram, & Lane, 2001; Weindruch & Walford, 1988). The most striking pay-offs are delayed senescence and increased lifespan—in some instances, nearly doubling the maximal age at death relative to normally fed controls. The CRL effect holds for animals that start out thin, fat or average weight, and is most pronounced at the lowest level of intake compatible with survival. The regimens used in such research, then, are not just slimming diets for inactive, overfed mice languishing in the laboratory; subjects on CR reach the rodent equivalent of the anorexic zone. Growth is retarded, body temperature is depressed,

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<sup>1</sup>The papers in this series assume familiarity with the clinical manifestations of AN and semi-starvation; for additional background on these topics, see Fairburn and Brownell (2002), Garner (1997), Keys, Brozek, Henschel, Mickelsen and Taylor (1950) and Polivy (1996).

fertility is impaired—yet on virtually every index considered by the CRL field, the semi-starved organism is better off in consequence.

On the strength of these findings, CRL experts predict that tremendous benefits would accrue if people could be persuaded to start undereating between the ages of 18 and 30 and remain hungry throughout their adult lives. Pilot research using human recruits was recently initiated in the United States, with funding from the National Institutes of Health. Some scientists are so confident of the results that they have already assigned themselves to a CR condition, reducing their own caloric intake by as much as 40%. A small but growing cohort of lay pioneers is following their example. Unsurprisingly, most of those who attempt the regimen fail (or fall back on such modest dietary restraint that their behaviour is better described as 'sensible eating' than CRL). A few of the most fervid, however, are maintaining levels of intake and weight consistent with laboratory animals on CR—or patients with AN. Little is known about these freelance restricters, but the bits of information available fulfill the predictions of both the CRL and ED fields. Short-term physiological changes conform to those seen in underfed rodents that survive to great age in excellent health (Fontana, Meyer, Klein, & Holloszy, 2004). On the other hand, the psychological and behavioural effects resemble symptoms of AN, including food preoccupation, binge eating, social withdrawal, loss of libido, extreme obsessiveness, cultivated food phobias, and the emergence of feelings of 'specialness' and superiority for the triumph of will over appetite (Manke & Vitousek, 2002).

Clearly, the two groups of researchers studying different aspects of CR need to become better acquainted. For a variety of reasons, it is incumbent on ED experts to take the lead in breaking through the artificial boundaries that have kept these scientific communities isolated and inbred. The papers in this series were written to facilitate that objective. The first and second summarize the vast animal literature on CRL, reviewing both the beneficial consequences that are featured by investigators and the deleterious effects that are obscured. The initial article (Vitousek, Gray, & Grubbs, this issue) provides a primer on the basics of CRL for an ED audience, outlining the protocols used and the physiological changes they produce. The paper also highlights the importance of considering the *context* within which CR occurs, comparing underfeeding in the laboratory to human restriction in the Biosphere 2 project and instances of AN. The second article examines what the CRL field does—and mostly

doesn't—know about the behavioural, social, cognitive and affective consequences of deprivation (Vitousek, Manke, Gray, & Vitousek, *European Eating Disorders Review*, in press). Researchers have shown little interest in these domains; however, the available evidence indicates that nutrient-dense CR in animals—just like nutrient-poor semi-starvation in people—is associated with numerous adverse effects. A third paper (Vitousek, Gray, & Talesfore, in press) addresses human applications of the paradigm, with specific proposals for increased collaboration—as well as confrontation—between the ED and CRL areas.

### WHAT'S IN IT FOR THE ED FIELD?

At first pass, it is easier to see what ED experts can offer CRL researchers than to recognize what they can do for us—at least in any positive sense. We have considerable knowledge about failed and 'successful' restriction in the species they are beginning to study, and some insight into what it takes to semi-starve outside the laboratory. A subset of our patients could also provide preliminary data about the physiology and health outcomes of chronic human CR, decades before more satisfactory answers might be obtained through controlled research (Vitousek, Gray, & Talesfore, in press). Indeed, two recent studies have already reported that a history of AN decreases subsequent risk of cardiovascular disease (Korndorfer et al., 2003) and breast cancer (Michels & Ekbom, 2004), supporting the CRL view that semi-starvation can be construed as preventive medicine.

By contrast, the most obvious effect of the CRL movement on our own work will be to make it more difficult. The scientific endorsement of semi-starvation will be confusing to many of our patients and exploited by some; certainly, it will muddle our message about the futility of dieting by the normal weight. We do not need to sound the alarm, however, about a looming epidemic of CRL in the general population. Americans have boosted their intake an estimated 300–500 kcal/day over the last 30 years (Putnam, 1999; United States Department of Agriculture, 2002), despite a barrage of publicity about the relationship between overeating and premature death. Publicity about the linkage between undereating and postponed death is unlikely to send millions charging in the opposite direction. If visions of immortality do inspire some people to trim back caloric excess, it may be good for their health—but it will not be CRL. Presumably, we

cannot expect to shatter the lifespan barrier simply by eating 300 fewer calories per day if we are currently eating 300 more than the generation that preceded us.

For the few who attempt the real thing, however, ED specialists would forecast less favourable outcomes. Far more will be left with a legacy of binge eating, increased adiposity and unwarranted guilt over the abandonment of extreme CR than will see their 130th birthdays. The rare individual who gets into the swing of semi-starvation will do so by picking up the monotonous rhythms and rituals of restricting AN. All the evidence suggests that radical CR is incompatible with a life—of whatever duration—that is genuinely lived 'at liberty' (Vitousek, Gray, & Grubbs, this issue).

Yet within these disheartening prospects, the CRL movement affords some extraordinary opportunities to our specialty area (Vitousek, Gray, & Talesfore, in press). While few ED experts would endorse the adoption of CRL by people—within or outside the context of research—we would be foolish to ignore an emerging phenomenon that we oppose but cannot control. Because semi-starvation affects so many aspects of functioning, efforts to decode the physiology and psychology of AN have always been hampered by the lack of an appropriate comparison group. When we detect peculiar neuropeptide levels or distinctive cognitive styles in individuals with AN, we cannot sort out the significance of those findings by comparing our patients to normal, psychiatric, or even dieting controls. The only satisfactory match for an otherwise healthy anorexic person with a BMI of 16 is an otherwise healthy *non*-anorexic person with a BMI of 16. For all the reasons reviewed in this series of articles, the latter virtually never occurs in nature—but does, very rarely, occur through freelance CRL. For the first time since the Minnesota Study (Keys et al., 1950), we have the opportunity to observe sustained semi-starvation in presumably normal individuals leading more or less ordinary lives in peaceful and prosperous societies.

In addition to the research opportunities afforded by CRL, the phenomenon may also help us see a familiar disorder from a fresh perspective. In cases of extreme CRL, we are witnessing the emergence of eerily 'anorexic' beliefs and behaviours in individuals (such as middle-aged males) at close-to-zero risk for a conventional ED (Manke & Vitousek, 2002; Vitousek, Gray, & Talesfore, in press). Moreover, we can often trace the origin of their stereotyped symptoms to a specific *idea* to which they were exposed at an identifiable point in time and

resolved to pursue consciously and purposefully. In their view, the costs of chronic CR are justified by its anticipated rewards—and many sane, serious scientists agree. In other words, the identification of a different *reason* for semi-starvation shifts the population 'at risk' and changes assessments of its rationality. Patterns that appear mysterious and pathological in the context of AN can be seen as sensible, even admirable, in the service of goals that observers understand and endorse.

Our own view is that both the pursuit of thinness and the pursuit of longevity are insufficient bases for radical restraint; however, if the example of CRL can illuminate the power of personally compelling motives for disordered eating, the ED field will benefit from giving it more thoughtful attention.

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