A source of thinspiration?

The biological landscape of media, body image and dieting

Over the past four decades women in industrialised countries have become wider, yet the ideal female physique, as depicted by the media, has become thinner. Twenty-five years ago, the average fashion model was only 8% thinner than the average woman. Today that figure has risen to 23% (Derenne & Beresin, 2006). During this time dissatisfaction with body size and shape has become so prevalent among girls and women that it is being described as ‘a normative discontent’ (Grogan, 2007).

More worryingly, body dissatisfaction is now appearing at increasingly younger ages. In a study by University of Central Florida, nearly half of the 3 to 6 year-old girls said they worried about being fat. Around one in three would change a physical attribute, such as their weight (Hayes & Tantleff-Dunn, 2010). The use of diet pills among 15-17 year olds has doubled in a five-year period (Neumark-Sztainer et al, 2006). Female preoccupation with physique and body dissatisfaction does not appear to diminish across the age spans and is now even exhibited by pensioners (Tiggeman et al, 2001; Ferraro et al, 2008).

Yet body dissatisfaction is more than a psychological and cultural issue. The methods used by an increasing proportion of girls and women to alter body shape are more than mere stylistic exercises in aesthetics. Body dissatisfaction has serious implications for female health and is a major risk factor for low self-esteem, clinical depression, self-harm, substance abuse, obesity, excessive dieting, and mood and eating disorders. As body dissatisfaction rises in increasingly younger children, so too has the prevalence of eating disorders and dieting. In the past decade, there has been an 80% rise in the number of young girls admitted to hospital with anorexia in England (DOH, 2009). With a mortality rate of between 10 – 20 per cent, the Royal College of Psychiatrists states: ‘Anorexia Nervosa has the highest death rate of any psychological disorder.’ (RCP, 2008).

Neurological correlates

A meta-analytic review of 25 studies entitled ‘The effect of experimental presentation of thin media images on body satisfaction’ concluded – as have others – that ‘body image was significantly more negative after viewing thin media images… mass media promulgate a slender ideal that elicits body dissatisfaction’ (Groesz et al, 2002). This negative effect is frequently reported to be both strong and immediate (Tucci & Peters, 2008). Analyzing
the brain activation patterns of females being exposed to media images is now illuminating the biological landscape of body dissatisfaction. Neuroscientists at Brigham Young University in Utah examined subconscious feelings about body image through fMRI analysis of the brains of healthy men and women who were assessed psychometrically as being confident about their bodies. It is known that when humans engage in serious self-reflection, activity increases in the medial prefrontal cortex (mPFC). It is suspected that this increased activation can betray subconscious thoughts. When anorexic and bulimic women view an overweight stranger, the medial prefrontal cortex is activated in ways that suggest extreme unhappiness and, in some cases, self-loathing.

In this study the healthy women looked at images of avatar-like models in skimpy bikinis. Some images were overweight, some very thin. On viewing each image the women were told to imagine that someone else was saying the model looked like her. When presented with overweight images, the mPFC showed increased activation in all of the women. Merely imagining that they might be overweight seemed to lead women to question their sense of self, even though they claimed afterward that the test was boring or meaningless.

Men showed no significant mPFC activation while processing either type of equivalent male image. The researchers concluded that there are ‘sub-clinical’ issues with body image among healthy women and a much finer line between women with and without eating disorders than previously thought. The lead researcher commented, ‘This is kind of validating the suspicion that most women are teetering on the edge of an eating disorder. If the brain response is so strong in these apparently healthy women…’ (Owens, Allen & Spangler 2010).

Related findings are also reported from Hiroshima University where healthy women and those with eating disorders were presented with morphed images of themselves and that of another woman. The pre-frontal cortex and the amygdala (implicated in processing emotional reactions such as fear, threat, anxiety and emotional responses to pain) were ‘significantly activated in healthy women in response to their own fat-image’. (Miyake et al, 2010)

Even the printed word elicits similar neurological reactions. The study ‘Gender differences in brain activity generated by unpleasant word stimuli concerning body image’ found that in women, words such as ‘obesity’, ‘corpulence’ or ‘heavy’ were accompanied by increased activation in the amygdala, while the left mPFC (associated with decision making and rational thought) became inactive. In men the response was the reverse. The authors believe that the mPFC is responsible for the gender differences in the processing of words concerning body image, and may also be responsible for gender differences in susceptibility to eating disorders. (Shirao et al, 2005)

**Electronic media and eating pathology**

As visual media of thin female physiques reaches further across the globe the neurological alterations cited above may be increasing among large sections of a population and at younger ages. In a landmark study, a multidisciplinary team from Harvard Medical School travelled to Fiji to evaluate the impact of the introduction of television on body satisfaction and disordered eating in adolescent girls. In Fiji, the ideal body weight for females has always been very full, while going thin – as Fijians refer to weight loss – is a cause for concern, not admiration. Dieting has been rare.

In 1995 television arrived and within three years everything changed. The percentage of subjects with pathologically high scores on a test for disordered eating more than doubled from 12.7% to 29.2% and three-quarters of the study population reported that they felt ‘too big or fat’. Dieting among teenagers who started to watch television increased dramatically to include two in every three girls and the rate of self-induced vomiting to control their weight, which had been rated as non-existent before television arrived, leaped to 11.3 per cent of that population. The girls openly cited thin female characters in American programmes as inspirations for changing their bodies. Comments included ‘I feel fat … I just admire them. I want their body, I want their size’.

The researchers describe the ‘dramatic increase’ in disordered eating. ‘The impact of television appears especially profound… Western media imagery may have a profoundly negative impact upon body image and disordered eating attitudes and behaviours, even in traditional societies in which eating disorders have been thought to be rare’ (Becker et al, 2002).

**Diet-induced biological changes**

A British study has found that more than one in four adults in the UK is trying to lose weight ‘most of the time’ (Mintel, 2004) either due to body dissatisfaction or genuine obesity. Yet
dieting is increasingly being found to be a major biological event, causing significant metabolic, neuroendocrine and epigenetic alterations, in some cases paradoxically leading to disease.

Tomiyama et al (2010) recently reported that restricting calories to 1200 kcal per day increased the total output of cortisol in females. Cortisol is important for regulating functions such as glucose metabolism and the inflammatory process. Prolonged exposure to high levels, however, can lead to higher blood pressure, suppressed thyroid function, impaired immunity, and increased intra-abdominal fat – all of which contribute to chronic disease states such as heart disease, diabetes and cancer.

The study also found that monitoring calories increased perceived stress and concluded: ‘Dieting may be deleterious to psychological well-being and biological functioning’. Stress has been linked to over-consumption of calorie-rich foods and concomitant weight gain in rodents, primates and humans. In mice Latagliata et al (2010) found that the stress of going on a diet affects the release of norepinephrine, which makes dieters hunt for food. The food-restricted mice were even willing to tolerate electric shocks to eat chocolate again because, through stress, ‘adaptive food seeking/intake can be transformed into maladaptive behaviours’ via ‘top-down’ prefrontal cortical noradrenergic control over eating disturbances.

Intermittent ‘yo-yo’ dieting is increasingly practiced in response to body dissatisfaction. It is generally ineffective in achieving enduring weight loss and the reasons for failure are become clearer. Cottone et al (2009) found that the brains of rats alternating between healthy and sweet (unhealthy) food in the way many dieters do, showed highly significant recruitment of neural circuits (CRF system) involved in stress reactions and promoted the ‘compulsive selection’ of unhealthy food and the undereating of healthy foods. This change in dietary preferences was accompanied by ‘a withdrawal-like state seen in drug dependence.’

Regarding the implications for the many humans who diet in this way, the author’s state, ‘motivational processes can become perturbed in individuals who experience repeated contrasts in the intensity of hedonic stimuli over time. Adaptively, such processes may shift food-seeking and consumatory behavior toward energy-dense, high-reward foods, while devaluing efforts to obtain less energy-rich, low-reward foods’. Cottone commented: ‘This eating pattern leads to a vicious circle. The more you cycle this way, the more likely it is you cycle again.’ Weight cycling averaging only 2.5kg over two-year periods among normal-weight individuals is strongly linked to ‘a higher risk of cardiovascular disease and death’. (Waring et al, 2010)

**Gene expression**

Many genes can be up-regulated or down-regulated by changes in behaviour and environment, through such external epigenetic mechanisms. Nutrition and diet-induced changes in gene expression are now increasingly reported. Dahlman et al (2009) randomly assigned overweight women to a moderate-fat, moderate-carbohydrate diet or a low-fat, high-carbohydrate hypoenergetic diet for 10 weeks. Irrespective of the type of diet, in adipose tissue ‘a total of 52 genes were significantly up-regulated and 44 were down-regulated as a result of the intervention’.

Tenomodulin (TNMD) is a transmembrane glycoprotein. TNMD gene expression in human fat tissue was down-regulated during diet-induced weight loss, with a 65% decrease after 18 weeks of dieting (Saiki et al, 2009). In both breast and abdominal tissue, significantly reduced expression of genes is observed in the lipid metabolism and glycolytic pathways following dietary energy restriction (Ong et al, 2009). The chronic dieting of anorexia nervosa is also accompanied by epigenetic changes in adipose tissue. Decreased body fat content of patients with anorexia nervosa was accompanied by a reduction in fat mRNA adiponectin, leptin, interleukin-6 and CD68 expression, while resistin mRNA expression was increased. (Dolezalova et al, 2007)

But in understanding the link between exposure to visual media of thin female physiques and the onset of eating disorders, to what extent can body dissatisfaction induce epigenetic changes which activate psychiatric disorders such as anorexia nervosa? Harvard Medical School molecular biologists Abdolmaleky et al (2008), examining epigenetic alterations of the dopaminergic system in major psychiatric disorders, believe that ‘environmental factors can influence DNA methylation patterns and hence alter gene expression. Such changes can be especially problematic in individuals with genetic susceptibilities to specific diseases. Recent reports from our laboratory provided compelling evidence that both hyper- and hypo-DNA methylation changes of the regulatory regions play critical roles in defining the altered functionality of genes in major psychiatric disorders’.

Psychological distress such as child abuse is now found to leave epigenetic marks on DNA
in genes that control our stress response, which then increases the risk of suicide (McGowan et al., 2009). A disturbed expression of dopaminergic genes has now been identified in eating disorders (Friedling et al., 2009). Can early or prolonged body dissatisfaction also leave epigenetic marks on DNA?

**Media and evolutionary adaptation**

Stepping back from the minutiae of gene expression, it is now possible to view exposure to high numbers of thin media images in an evolutionary context, activating an adaptive selection mechanism and distorting it so it becomes maladaptive.

Heterosexual human females maintain/adapt their physical appearance in accordance with sexual dimorphism – the systematic difference in form between individuals of different sex. In females, more subcutaneous fat and fat deposits mainly around the buttocks, thighs and hips are central to sexual selection. The waist-hip ratio of any physique is very strongly correlated to male perception of female attractiveness across all cultures and throughout history. This is a key health and fertility indicator and core feature of feminine beauty (Singh et al., 2007).

Exposure to visual images depicting attractive females is found to alter women’s perception of their own sexual attractiveness and mating viability through a cognitive comparison process referred to as the contrast effect (Gutierrez et al., 1999).

The contrast effect is the enhancement or diminishment of perception, cognition and related performance as a result of previous exposure to a stimulus of lesser or greater value in the same dimension (e.g. weight, height, luminescence). Contrast effects are ubiquitous throughout human and non-human animal perception and cognition. In terms of evaluating one’s own attractiveness, one appears more attractive when contrasted with a person less attractive and less attractive when contrasted with one of greater attractiveness. Indeed, women are most highly satisfied with their own body image when exposed to images of females wider than themselves (Tucci & Peters, 2008).

Until recently these self-evaluations of body attractiveness involved comparisons with a relatively small number of other women in the local mating pool. However, today’s culture is unique: the points of comparison provided by visual media which women use in their self-evaluations are not only profuse and omnipresent but are demographically atypical, with no geographic relevance to the given female concerned. Such images are often of women of high media status. As the Royal College of Psychiatrists (RCP, 2010) stated: ‘There is a lack of reality-based imagery… propagating unattainable body ideals … the norm through extensive use of digital enhancement or airbrushing.’

In short, from an increasingly earlier age, females today are exposed to evolutionarily novel stimuli that deceive cognitive and neurological processes whose function developed to evaluate other females in a small-scale local mating pool. The result is the widespread body image distortion and dissatisfaction, reported above, and adaptive behaviours often at odds with sexual dimorphism and sexual selection. As females use atypical media physiques to establish cognitive norms as points of comparison and adapt their self-presentation accordingly through misguided dieting and disordered eating, it has for many become a case of ‘keeping up with the Boneses’.
Conclusions
There has been a decided shift in position by scientists and prominent medical bodies in considering media images as being causative. Spettigue and Henderson (2004), for example, concluded: ‘The media is a causal risk factor for body dissatisfaction, negative effect and eating pathology’.

The Royal College of Psychiatrists has issued a 'Statement on the influence of the media on eating disorders' (2010). 'The media has a role in both providing a social context for the development and maintenance of eating disorders ... achieved by propagating unobtainable body ideals and the acceptability of dieting leading to lowered mood, body dissatisfaction and eating disorder symptoms. There is a lack of reality-based imagery'.

In their 'Summary and Call for Action', they demand the 'use of role models throughout the mass media that cover a diversity of weight, shape, age... cessation of the use of underweight models... raising awareness of use and extent of digital manipulation of images through use of a kite mark'.

There is good reason for these strong reactions as few realise the sheer prevalence and mortality rate of anorexia nervosa. In the UK, 1.4m females currently have an eating disorder. Of these 140,000 have anorexia (NICE, 2004) and with a 10% mortality rate, approximately 14,000 will die. If only 5% of these deaths could hypothetically be attributed mainly to the effects of exposure to thin media physiques, this equates to 700 deaths. This is far greater than the number of women in the UK killed each year through domestic violence (approximately 100) or from heterosexually contracted HIV/AIDS (38) per annum.

A decade ago, the British Medical Association’s Board of Science and Education demanded ‘a more responsible editorial attitude towards the depiction of extremely thin women as role models’ (BMA, 2000). Yet matters have become much worse. Traditionally, suggestions that media images are causative are deflected by the rationalisation that ‘the media merely reflects society and are being used as a scapegoat for body dissatisfaction and eating disorders’.

However, the biological sciences have now provided a deeper understanding of the precise role of media physiques in these pathologies. In other areas of child and public health, exposure to causative risk factors for disease are ultimately controlled through legislation. As thin media physiques are now a biologically based medical issue, it raises the question of whether assertive guidance should in future emanate from the Department of Health as opposed to the Department for Culture, Media and Sport.

There is already a precedent for media policy and legislation based upon the biological characteristics of people represented on television screens, for example, there is racial diversity and gender legislation. The BBC, for instance, ‘is committed to reflecting the diversity of the UK audience… in its output on TV, on radio and online.’ At the same time, an ongoing issue is the de-selection of females whose biological characteristics include grey hair and/or wrinkles on all electronic media networks in most Western industrialised countries. Following this logic, female physique is yet another biological parameter which could be considered an aspect of diversity.

Both the BMA and the RCP have called for media physiques ‘that cover a diversity of weight, shape, age…’ Implementing this policy will require a new-found enlightened intolerance towards images deemed harmful, i.e. the incorporation and active exclusion of media physiques according to their degree of risk to young female viewers. While most concern has surrounded thin fashion models, greater risk may lie in the more everyday ambient images of ‘permarexic’ – visibly unhealthily thin – children’s television presenters, actresses and innocuous newscasters who form the backdrop to the visual lives of girls and women. At a practical level, a minimum standard of risk acceptability would have to be established based upon visual physique parameters such as waist-hip ratio and dress size. Alternatively, ensuring that a roughly accurate proportion of female media images are an average UK dress size 16.

This may seem an extraordinary form of social medicine but the evidence suggests that ‘a lack of reality based imagery’ in media is causing health problems in a very large number of women and young girls. And so it appears that while men eat food, women have a relationship with food. This relationship has grown increasingly dysfunctional. Forty years after the debut of body politics, biology is explaining more precisely why fat is a feminine issue.

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Further reading and references can be found at www.societyofbiology.org/biologist
REFERENCES

** Statistic for deaths with HIV. Health Protection Agency (2010) Source: Data Request 12 July: 38 non African heterosexual women with HIV (14 years and over) died in the UK in 2008.


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