



# An unsuitable and degraded diet?

## Part three: Victorian consumption patterns and their health benefits

Judith Rowbotham<sup>1</sup> • Paul Clayton<sup>2</sup>

<sup>1</sup> Nottingham Trent University – School of Arts and Humanities, Clifton Lane, Nottingham W8 7NP, UK

<sup>2</sup> School of Life Sciences, Oxford Brookes University,

Correspondence to: Judith Rowbotham. E-mail: jrowbotham@gmail.com

### DECLARATIONS

#### Competing interests

PC provides consultancy services to a number of companies in the food and drink, supplement and pharmaceutical sectors, including Coca Cola Ltd, Univite Ltd, Biothera Pharma. JR is a historian who provides no consultancy services to anyone on any commercial basis, but provides academic comment to media and academic outlets, including *Woman's Hour*, European Social Science History Conference, etc.

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### Introduction to part three

#### Principal findings

Where our previous two papers documented the volume and variety of the mid-Victorian diet, this final paper reveals that the mid-Victorian diet conferred extremely significant protection against the major degenerative diseases, even amongst those who, because of their extremely limited incomes, might be considered to be significantly undernourished and so vulnerable to such afflictions.

#### Methods, strengths and weaknesses

We cross-refer dietary patterns against life expectancy figures and public health profiles, drawing together data from the previous papers. Admittedly, detailed quantitative data in readily digestible forms do not yet exist for the whole nineteenth century. Records of causes of death<sup>1</sup> are not given in the kind of detail that modern medical specialists would desire. However work, such as ongoing ESRC-funded research on sickness claims, is now amplifying existing records and understanding of morbidity in the nineteenth century.<sup>2</sup> Its findings already complement the conclusions about life expectancy highlighted in this series. A further strength of this paper is that it allows us to develop a series of hypotheses about the relationships between diet and health which are eminently testable.

#### Meanings, unanswered questions and future research

In looking for lessons from the past for the present, we argue that these findings indicate a need to reconsider how best to achieve equivalent levels of nutrition in today's population, given that State exhortation has not (despite significant investment) markedly improved the nation's health. Today's lower calorific requirements

reduce nutrient intake compared to the c3500 to 4500 calorific throughput for mid-Victorians; a problem exacerbated by issues such as food availability, price and choice. In considering the data from a pharmaconutritional perspective, we argue that they provide substantial support for the use of functional foods and/or supplements to improve the nutrient/calorie ratios of the modern diet, as a way of improving public health and reducing health-care expenditure. Future research should focus on multiple-input nutritional intervention studies, measuring the impact of pharmaconutritional support programmes derived from mid-Victorian dietary values on clinical endpoints. If these provide positive results, they should enable a cost-effective shift from the currently-favoured disease management model of healthcare to substantive public health improvement through diet.

#### Life expectancy, life quality and public health patterns

A common view remains that in the mid-Victorian era life was brutish and short: 'The average life span in 1840, in the Whitechapel district of London, was 45 years for the upper class and 27 years for tradesman. Labourers and servants lived only 22 years on average'.<sup>3</sup> However, these figures rely too heavily on crude averages culled from registers of births and deaths which belie the reality of adult experience of old age, as well as extrapolating for the whole of the century the miseries of the Hungry Forties. The most effective way of assessing the overall impact of the mid-Victorian diet on health is to look first at the available public health data and related data, including the major causes of death and life expectancy, plus recent work on, for instance, working-class height in the nineteenth century.

**Ethical approval**

Not appropriate or relevant: all modern data cited is already in the public domain, and all historical data is either anonymized or untraceable

**Guarantor**

PC

**Contributorship**

This series of three papers was jointly conceived and researched. JR took primary responsibility for searching out both the primary historical sources and the relevant secondary references; PC took primary responsibility for searching out the scientific and medical data. The general tenor and conclusions of the papers (including the exercise of drawing up dietary patterns and levels of physical activity which are summarized in the first and second papers) are a joint effort, representing 50% input from each contributor. While comment on penultimate drafts was sought from specialists in both the historical and scientific/medical fields, no other

Victorian patterns and views of mortality were unlike our own. The relative swiftness of deaths from infectious disease in the mid-Victorian era (compared to today, when palliative medicine typically extends the dying phase by years) affected their perspectives: 'Death came swiftly, as always in these cases [of infection], and in a day the child's life ebbed away'.<sup>4</sup> Infant mortality rates were unquestionably high, and around 50% of all infant deaths at all levels of society was due to infectious diseases.<sup>5</sup> In 1856, Archbishop Tait lost five of his children in five weeks to scarlet fever. This was by no means exceptional. 'I learn from the statistical tables that one child in five dies within the first year of its life; and one child in three, within the fifth'.<sup>6</sup> Due to the impact of the infectious and epidemic diseases, mid-Victorians tended to regard death as an anticipated and a communal experience and, being a more religious age, such expectations of death were couched in terms unfamiliar today: 'the Lord gives strength to bear death, and how good it is to feel that we have a family to greet us in heaven'.<sup>7</sup> Today's intensely personalized perspective is due to increased secularism and to the recent emergence of non-communicable diseases as prime causes of death.

Once the dangerous childhood years were passed, however, Victorian contemporary sources (including regional variables) reveal that life expectancy in the mid-Victorian period was not markedly different from what it is today.<sup>1,8</sup> Once infant mortality is stripped out, life expectancy at age five was 75 for men and 73 for women.<sup>9,10</sup> The lower figure for women reflects the danger of death in childbirth or from causes that were mainly unrelated to malnutrition. This compares favourably with present figures: life expectancy at birth, reflecting our improved standards of neo-natal care, currently averages 75.9 years for men and 81.3 years for women.<sup>A</sup> Recent work has suggested that for today's working-class men and women (a group more directly comparable to the mid-Victorian population) this is lower, at around 72 years for men and 76 years for women.<sup>11</sup> This relative lack of progress is striking, especially given the many environmental disadvantages during the mid-Victorian era and the state of medical care in an age when modern drugs, screening systems and surgical techniques were self-evidently unavailable. Health expectancy provides valuable nuance. Mid-

<sup>A</sup>The improvement in female life expectancy since the mid-Victorian period is linked to family planning; until accessible family planning facilities arrive in the inter-war period, women's health was substantially undermined by up to 30 years of successive pregnancies and births.<sup>1,16,n1</sup>

Victorians enjoyed relatively good health in old age; many elderly, including inhabitants of workhouses (so called because the inhabitants were expected to contribute to their upkeep), were capable of working until the last few days or even the last day of their lives.<sup>12</sup> Hospital beds were limited not just because so many were nursed at home, but also because of the lesser need for non-acute medical facilities. Twenty-first century males can expect to spend the last 7.7 years of their lives in a state of increasing medical dependency, while for women the figure is in excess of 10 years.<sup>13,14</sup> From this viewpoint, the medical gains of the last century may simply appear a bit tarnished but actually the implications of this new understanding of the mid-Victorian period are rather more profound.

The well-worn theory that links modern health-care with increased adult life expectancy is all to do with your starting point. As the start point is inevitably set at 1900, when life expectancy at birth was around 50 for both men and women,<sup>5</sup> then the last century has apparently seen astonishing medical progress: 1900, however, provides a highly misleading baseline. By 1900, the substantial *decline* in nutritional standards since the 1880s had adversely affected the national health to such an extent that life expectancy for young males was affected.<sup>1,9,15</sup> Ironically, the habit of giving the 'treats' or luxuries to men, plus the essentially masculine nature of the habit of smoking amongst the working-classes, had affected men more significantly than women.<sup>16</sup>

The importance of choosing the right baseline is further illustrated by looking in more detail at the period prior to 1850. Before the development of the rail networks, ineffective food distribution into the inner cities was an important factor in the negative impact of urbanization on working-class health, along with the higher prices guaranteed by the Corn Laws. Urban male height in particular fell after the Napoleonic Wars, with the greatest effects being visible on the birth years from 1835 to the mid-1840s (justifying the description of the 'Hungry Forties'), but climbing thereafter; indicating that 'men growing up in England before 1850 suffered a major food, environmental or work effect "insult" but that this was subsequently significantly remedied'.<sup>17</sup> By the mid-1850s, though, even children were benefiting from the improvements in nutrition; and this is reflected in the mid-Victorian life expectancy figures cited above.

Taking the mid-Victorian period as the starting point, it is clear that – with the exception of family planning – the vast edifice of twentieth century healthcare has not so much enabled us to live longer but has predominantly supplied methods of

contributor was directly or substantially involved in the writing of these papers or the research thereof. Those cited have been cited where the contributors judged that their work was relevant and supportive, or where we wished to identify work that we wished to challenge

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suppressing the symptoms of non-communicable degenerative diseases. These have emerged, we submit, largely due to our failing to maintain mid-Victorian nutritional standards<sup>18</sup> (Figure 1).

### Public health patterns

The overall pattern of mid-Victorian causes of death<sup>4</sup> broadly resembles that found in developing countries today, with infection and perinatal mortality. Accidents at work, in public spaces or in the home were also major causes of death as the records of insurance societies reveal.<sup>n2,n1</sup> Non-communicable degenerative diseases were relatively insignificant.

### Common causes of death

Infection includes tuberculosis and other respiratory tract infections such as pneumonia; epidemics (scarlet fever, smallpox, influenza, typhoid, cholera, etc.), the spread of which was often linked to poor sanitation; and sexually transmitted diseases (e.g. syphilis).<sup>1,19</sup> Perinatal mortality<sup>1</sup> was generally also due to infection, although maternal haemorrhage was another significant causative factor.

Deaths caused by accidents and trauma were usually linked to workplace and domestic conditions. Death from burns was an important cause of death among women, due largely to a combination of open hearth cooking and fashions in dress.<sup>1,19</sup> The lack of manoeuvrability conveyed by corseting and the sheer weight of a woman's attire (the fabric alone could amount to around 30lb or more, with an additional weight of steel in corsets and crinolines and horsehair plus steel in bustles) ensured that they were particularly susceptible to accidents.<sup>n3</sup>

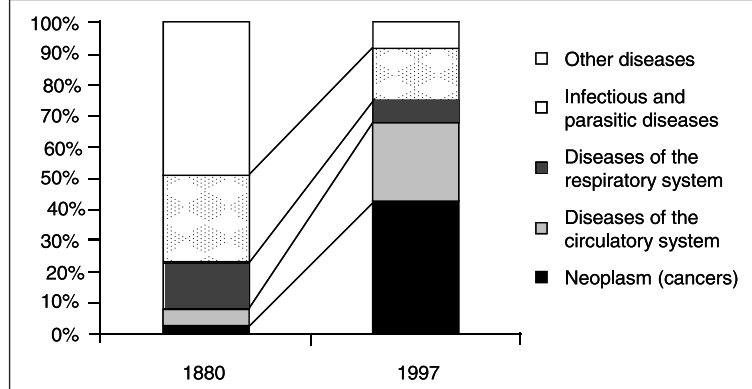
Heart failure was generally due to mitral stenosis caused by rheumatic fever rather than coronary artery disease, and so cannot count as a degenerative disease.<sup>20</sup> Angina pectoris does not appear in the Registrar General's records as a cause of death until 1857 (and then as a disease of old age) although the diagnosis and its causes were recognized.<sup>1,19,21-24</sup>

### Uncommon causes of death

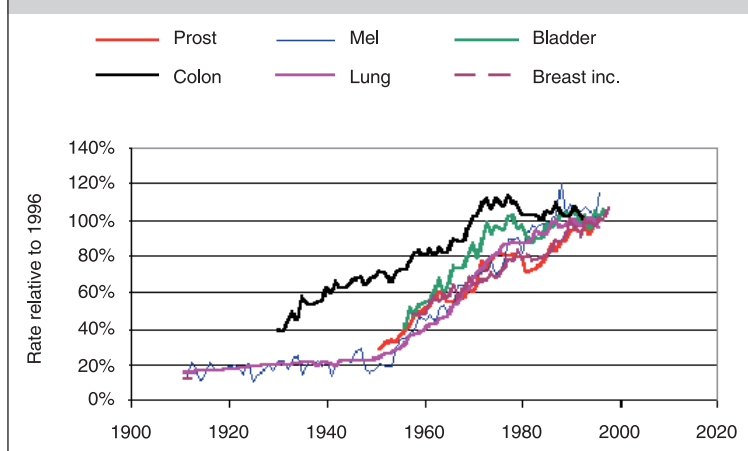
As stated above, coronary artery disease as a cause of death was rare. Paralytic fits (also called strokes)<sup>25</sup> were mainly associated with the middle and upper classes, who ate a diet in which animal derived foods had a more significant role, and who consumed fewer fruits and vegetables as a result. Strokes were generally non-fatal, at least the first time; although mortality rates increased with each subsequent stroke.<sup>19</sup> Cancers were relatively rare.<sup>19</sup> While the Victorians did not possess sophisticated diagnostic or screening technology, they were as able to diagnose late stage cancer as we are today; but this was uncommon. In that period, cancer carried none of the stigma that it has recently acquired, and was diagnosed without bias. For example, in 1869 the Physician to Charing Cross Hospital described lung cancer as 'one of the rarer forms of a rare disease. You may probably pass the rest of your students life without seeing another example of it.'<sup>26</sup>

Not only were cancers very uncommon compared to today, they appear to have differed in other respects. James Paget (of Paget's disease and a former RSM President) built a large practice on the strength of diagnosing breast cancer, which he did by sight and palpation; that is, at Stages 3 and 4. In one group of 139 patients he reports an average life expectancy of at least four years after diagnosis, with a maximal survival time of 18 years.<sup>n4</sup> Note that Paget is specifically giving conservative life expectancy figures, for reasons that he outlines in the paper. The corresponding figures today are: Stage 3, 50% survival at ten years if given surgery, chemo- and radio-therapy; Stage 4, overall survival about 15 months. These figures suggest that breast cancer during the mid-Victorian period was less rapidly progressive than is the case today, and the speculation is such differences are due to the mid-Victorians' significantly higher intakes of a range of micro- and phytonutrients, which created a *milieu interieur* less conducive to cancer growth. This is reviewed in greater detail in the section on pharmaconutrition, below.

**Figure 1**  
Cause of death in England and Wales, 1880 and 1997.<sup>9</sup>



**Figure 2**  
Cancer trends: Sweden.<sup>73</sup>



Historical cancer data from Sweden indicate that soon after the end of the nineteenth century the incidence of at least two of the most significant cancers was around 20% of today's figures. It is important to note that the earliest data here relate to a time when we argue that nutritional values had already declined from their mid-Victorian apogee. Figure 2 shows that cancers of the prostate, breast, lung, bladder and colon have doubled since the 1950s, as has melanoma. The Swedish figures are very similar to our own, and to cancer trends in general; although in some countries, cancer rates have increased even more rapidly.<sup>27,28</sup>

### Surveying mid-Victorian nutrition from the original sources: basic elements

Our study of the mid-Victorian period shows that in marked contrast to the received wisdom, the mid-Victorians enjoyed high standards of nutrition. It indicates that a reversion to mid-Victorian nutritional values would significantly improve our own health expectancy.

### Pharmaconutrition

In considering the results of such a diet, a number of positive comments can be made. Given the strong links between tobacco consumption and both vascular disease and cancer, and given that industrial cigarette manufacture only arrives in the mid 1880s, it is unsurprising that the mid-Victorian incidence of these two categories of disease is lower than today. However, analysis of their diet reveals that due to their higher intake of fruits and vegetables, containing higher levels of phytopro-

TECTIVE compounds than are found today,<sup>29,30</sup> the mid-Victorians consumed significantly higher levels of many dietary factors which possess cardio- and chemo-protective properties. It is our belief that this contributed substantially to their vastly lower rates of degenerative disease. We will concentrate our comments on cardiovascular disease, cancer, and atopy; however, similar comments could be made for other degenerative diseases.

### Cardiovascular disease

The mid-Victorian diet contains higher levels of vasoprotective flavonoids, omega 3 polyunsaturated fatty acids, the B vitamins, and the classic antioxidant vitamins and mineral co-factors.<sup>31,32</sup> The glycaemic load of the mid-Victorian diet was arguably higher than ours due to the consumption of large amounts of potatoes, bread and other baked goods; but this was effectively off-set by their very much higher levels of physical activity. They ate a diet roughly comparable to the Mediterranean diet in terms of the preponderance of plant-derived foods: a diet known to reduce the risk of heart disease<sup>33,34</sup> and Type 2 diabetes.<sup>35-37,n5</sup> More specifically, mid-Victorians consumed high levels of vasoprotective flavonoids, omega 3 PUFAs, the B vitamins, and the classic antioxidant vitamins and mineral co-factors.<sup>31,32</sup> The glycaemic load of the mid-Victorian diet was arguably as great or greater than ours, due to their consumption of large amounts of potatoes and bread; nonetheless, reflecting their very much higher levels of physical activity, Type 2 diabetes is uncommon during this period.<sup>n6</sup> Superior blood glucose control combined with enhanced vasoprotection and a low sodium intake would lower the risk of vascular cognitive impairment, and combined with a higher intake of flavonoids and omega 3 polyunsaturated fatty acids would be expected to reduce the risk of Alzheimer's disease<sup>38</sup> and age-related cognitive decline.<sup>39,40</sup>

### Cancer

The mid-Victorian diet contains higher levels of a range of dietary factors which have, *inter alia*, the capacity to up-regulate Phase 2 enzymes positively affect multiple gene expression and signalling pathways, induce cancer cell cycle arrest, apoptosis and redifferentiation, and inhibit angiogenesis. Chemoprotective dietary factors include the plant-derived salicylates, flavonoids, limonoids, carotenoids and xanthophylls, and the less familiar protease inhibitors (e.g. from legumes),<sup>41</sup> matix

metallo-protease (MMP)-inhibitors (e.g. from berry fruits)<sup>42</sup> and prebiotic fibres (e.g. from the widely-consumed Jerusalem artichoke).<sup>43,44</sup> The diet which most resembles this today, the Mediterranean diet and variants thereof, is linked to a lower incidence<sup>34,45,46</sup> and slowed progression of cancer.<sup>47,48</sup>

In addition to the above, the relative lack of sterility of the food chain at that time meant that the mid-Victorian was subject to constant low-level immunological challenge by microorganisms, including yeasts. The 1–3,1–6- $\beta$ -glucans present in yeast cell walls stimulate the toll-like receptors TLR2 and TLR6 on all innate immune cells,<sup>49</sup> and the equally important CR3 receptor,<sup>50–52</sup> substantially up-regulating their activity.<sup>53,54</sup> This would account not only for the relative rarity of food poisoning in the mid-Victorian period (despite their lax, by present standards, food safety regimes), but would also have contributed to a reduced risk of cancer via enhanced activity of Natural Killer cells and tumoricidal granulocytes.<sup>55</sup>

Mid-Victorian cooking techniques produced lower levels of carcinogens than is the case today. Formation of cooked meat carcinogens is linked to cooking temperatures and durations; the preponderance of high-temperature frying and grilling used in the production of fast foods today has exposed us to relatively high levels of these compounds.<sup>56,57</sup> In practice, fuel costs and cooking techniques meant that working-class mid-Victorians cooked foods at lower temperatures, even when they did grill or fry.<sup>58</sup> Their habit of boiling meats with onions was also positive, as this cookery method reduces mutagen formation.<sup>59,60</sup> The Mid-Victorian high consumption of legumes, watercress and other brassica would have provided further chemo-protection via up-regulation of excretory Phase 2 enzymes.<sup>61</sup>

Mid-Victorian exposure to carcinogens was therefore probably lower than today, apart from certain well-defined occupational cases such as the chimney sweeps. The relative scarcity of tobacco until the mid-1880s removed, at a stroke, the bulk of the effects of today's most important carcinogen, as did the relative paucity of alcohol.

### Atopy

It is well known that the risk of asthma and allergy, which have increased dramatically over the last three or four decades, is higher among communities where high levels of hygiene are implemented, particularly in the food chain. This is known as

the hygiene hypothesis, and appears to explain the very high incidence of asthma and allergy in Scandinavian and in English-speaking countries. Constant low-level stimulation of the innate immune system due to microbial food contamination, as occurred in the less well-regulated Victorian era, has been shown to increase Th1/Th2 cell ratios, constituting a powerful anti-allergy mechanism.<sup>62,63</sup> Mid-Victorians ate significant amounts of yeast: their relatively ineffective fungicides (elemental sulphur and copper) left traces of yeast in all plant-derived foods. Particularly rich sources of yeast included fermented breads and beverages. Subsequent developments in food technology such as the Carbonic Acid Gas Method and Chorleywood Process for bread, and ultra-filtration for beers and wines, reduced levels of yeast in the diet dramatically; as had the development of the organic fungicides since 1934.<sup>n7</sup> In addition, the mid-Victorian plant-rich diet contained higher levels of a number of other immunomodulatory compounds (such as sterols)<sup>64,65</sup> and anti-inflammatory compounds (such as the flavonoids and flavonols)<sup>66</sup> and, to a lesser extent, the omega 3 fatty acids. Asthma was recognised and discussed by physicians such as Hyde Salter (himself an asthma sufferer) and William Osler, but though it was agreed to involve an inflammation of the mucous surfaces, resulting in muscular contractions, it was not held to be a life-shortening condition, or (despite mid-century urban and workplace pollution) a common one. Its management was usually associated with placing the sufferer (where possible) in a more 'hygienic', or less polluted, environment. In an individual who did develop allergy or asthma, therefore, the symptoms were generally less severe than is the case today; as indicated by contemporary sources.<sup>n8</sup>

### Conclusion

Healthy adult life expectancy increased rapidly after the undoubted miseries of the Hungry Forties due to the rapid improvement in the range of vegetables and fruits available to the urban poor. It reached a peak during the mid-Victorian period and fell back at the end of the century, the damage caused by the first generation of mass-processed foods only partly mitigated by the environmental and medical advances of the time. The apparent increases in life expectancy cited today depend heavily on the chosen start date, and as we have shown, 1900 (while mathematically convenient) provides a misleading baseline. Given the current pandemics of obesity and diabetes, and given that

life expectancy is now falling in areas as diverse as Strathclyde, much of Africa and the FSU, and within significant social strata in the USA;<sup>n9</sup> the confident concept of inevitably increasing life expectancy no longer convinces.

If we start from a mid-Victorian baseline, the picture changes dramatically. The mid-Victorians were living in an age without modern diagnostic tools, drugs, contraception or surgical techniques and yet (as the first paper in this series emphasized) their life spans were not dramatically different from those of today. The inescapable message is that the brief dietary advances of the mid-Victorian period have been lost to us because of our low calorific throughput (due to our more sedentary lifestyles), as well as the increased consumption of processed, and in many cases less nutritious, foods.

This series relies heavily on viewing nineteenth century public health through the lens of current comprehension of the causes of degenerative disease, and derives proposals for the role of nutrition in remedying twenty-first century health problems. Published data indicates that this role is significant, but is largely based on epidemiological evidence or relatively small-scale intervention studies. What we provide here is a sustained, mass study which confirms the suggestions made by a range of authors on the impact of improved individual nutrition, based on informed choices. We do not argue that the mid-Victorian working-classes understood the impact of their dietary habits, and accept that their choices were restricted by poverty and food availability. But due to the availability of cheap fruit and vegetables, and high levels of calorific throughput, we have shown that the mid-Victorians ate a diet which transcends, in many respects, the contemporary Mediterranean diet. This is a diet strongly linked to a reduced risk of diabetes,<sup>35,67</sup> cardiovascular disease,<sup>68</sup> cancer,<sup>46</sup> dementia,<sup>38</sup> COPD<sup>69,70</sup> and indeed to death from all causes,<sup>45,71</sup> at a period in world history when the infectious diseases have been significantly brought under control.

Given that the great public schemes of clean air and water did not become significant until the 1890s, and given the mid-Victorians' relative immunity to degenerative disease, it is not surprising that infection remained the major cause of death up until the early twentieth century. What is surprising is that in our rush to embrace the pharmaceutical model of healthcare (which largely springs from the success of the early antibiotics), we have allowed the nutritional wisdom of the mid-Victorian era to be squandered.

The uncomfortable facts for policy-makers – that adult life expectancy has changed so little since the mid-Victorian period and that health expectancy may have actually diminished – refute the argument that our increased incidence of cancer and other degenerative diseases is merely an attribute of increased longevity (the 'wear and tear' hypothesis); and strongly suggests that the non-communicable diseases that dominate public health today are largely caused by our low-energy life-style and consequently poor nutritional status. The description of such conditions as 'degenerative' or entropic is not only a failure of intellect and imagination, but has also created a climate of medical nihilism. We submit that it would be more accurate – and very much more productive – to re-designate these pathologies as low throughput disorders. From this perspective degenerative phenomenology is largely due to catabolic dominance, caused by a chronic lack of both anabolic co-factors such as vitamins and minerals, and anti-catabolic factors such as many of the new phytonutrient categories; and largely preventable – perhaps even treatable – with broad spectrum and appropriate nutritional support. The lack of efficacy and/or potential dangers of monotherapeutic nutritional intervention (i.e. with beta-carotene) are well documented.

The World Health Organization has already commented that a large part of the burdens of ill health in the OECD nations stem from the inadequate diets of their populations. Today's inadequate diets have little to do in most cases with the cost or availability of food, but are determined by poor food choices and our low calorific throughput. We have demonstrated that, for all their constraints, and in contrast to received wisdom, working-class families in the mid-Victorian era obtained better nutrition than many do today and enjoyed better health as a result.

A return to mid-Victorian eating habits is not feasible, given their high calorie intake and our low-energy lifestyles. This would exacerbate our already alarming rates of overweight and obesity, problems which were uncommon and mostly confined to the urban upper middle classes in the mid-Victorian period but which have become major public health concerns today. Instead, we recommend that the modern diet be re-engineered, integrating the micro- and phytonutritional elements of the mid-Victorian 3500–4000 calorie/day diet into the modern 2200 calorie/day diet. We accept this will not be easy. Educating individual choice, as the efforts of the Food Standards Authority show, takes time to have an impact: but if the

results of this series are taken seriously, then at least better-grounded advice can be offered. The realities of a need to promote an intake of nutrients at a level not naturally available in today's 2200 calorie/day diet does require the vexed issue of food fortification and supplements to be included in strategic public health policy formation. Inevitably, this also means that it will have to be reflected in the regulatory sphere.

Demands are now being made that public health policymakers find strategies to remedy the alarming decline in individual health.<sup>72</sup> But while research teams are studying dietary intakes for different groups, attempting thereby to ascertain the ideal intake of omega 3 PUFAs to reduce the risk of Alzheimer's, or the optimum dose of flavonoids to reduce the risk of stomach cancer, our work suggests that these efforts are misdirected. Current generations are, historically, completely atypical. Our abnormally low levels of physical activity and consequently food intakes mean that even those groups consuming the highest levels of berry fruits, green leaf vegetables or oily fish are still well below optimal (mid-Victorian) levels of consumption. So although pharmacological levels of compounds such as flavonoids, glucosidates or salicylates have strong chemo- and cardio-protective properties *in vitro*, there is little evidence that current dietary (physiological) intakes have significant protective effects in humans. The mid-Victorians were actually consuming pharmacological levels of these compounds. This, we believe, is why they were so effectively protected against the degenerative, non-communicable disorders, and is one reason why we are so prone to these largely avoidable diseases today. We believe also that the on-going search for disease susceptibility genes is largely misinformed. The mid-Victorian gene pool was not significantly different to our own, yet their incidence of degenerative disease was approximately 90% less.<sup>9</sup> In the high-nutrient mid-Victorian environment the vast majority of the population was protected; and the combination of high levels of physical activity and an excellent diet enhanced the expression of a coordinated array of health-promoting genes.<sup>47,10</sup> As the nutrient tide has receded, increasing numbers of genetic polymorphisms have become exposed,<sup>11</sup> making current genome-wide association studies (GWAS) largely redundant. It follows that the pharmaceutical industry's attempts to develop genomically derived and individualized treatments such as RNA interference and ISPC are unlikely to impact on public health. In these papers we have tried to demonstrate the complexity of the

issues involved, and challenge the usefulness of a reliance simply on public health policy-driven exhortations to remedy the ills of the day.<sup>18</sup> There are, of course, many unanswered questions, but future research measuring the impact of a modernized version of the mid-Victorian diet on biomarkers and/or clinical end points in a series of primary or secondary intervention studies would help to resolve them. Detailed outlines for many of these are developed elsewhere.<sup>12</sup>

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### Additional references

These references were added at proof stage after the authors received feedback on the first two articles of the series.