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Review Article

Obesity, Diabetes and the Changing Environment

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Abstract

Obesity, undernutrition and diabetes are linked to the environment. We live in a rapidly changing environment. Population expansion is making a dramatic impact on climate change and have a dramatic effect on both health and food production.

The rise in obesity in children is due to our changing environment, where unhealthy food and beverages are so heavily advertised and where exercise opportunities are being diminished. Answers to the problem are available and discussed in this article. The rise in diabetes is related to obesity. Diabetes is a disease which places a considerable economic burden on the community and is associated with reduction in productivity and increase in years of disability. Curbing obesity and encouraging exercise will diminish diabetes and is of proven value.

The place of chemicals and toxins in the cause of the diabetes explosion is poorly researched but may play a part.

The population increase over the past decades has not levelled off as had been expected and is not sustainable. Efforts to decrease birth rates have not been sustained but are possible and of proven effectiveness. 40% of pregnancies are unplanned and unintended.

Climate change has made a dramatic effect on weather patterns. Fires and floods are an important cause of illness, disability and loss of productivity. Changes in our agricultural methods must occur if we are to feed the increasing population with healthy, rather than unhealthy, food in the quantities we require. In particular, red or processed meat production is inefficient as a way of increasing healthy food production and there are many health hazards associated with meat as a food.

Obesity, undernutrition and climate change is considered a pandemic. The tools for change are available. Political will less evident.

Keywords: *Obesity; Diabetes; Undernutrition*

Introduction

Obesity has become an epidemic and brings with it an increase in diseases which decrease life expectancy. In 2016 more than one third of adults worldwide were classified as overweight or living with obesity [1]. Alas with a decrease in life expectancy comes the burden of ill health and the utilisation of health care resources. The diseases that come with obesity include diabetes, hypertension and accelerated atherosclerosis which results in heart attacks, heart failure, strokes and amputations. Obesity is associated with an increase in cancer risk particularly breast and colon [2-5]. Fatty liver going on to cirrhosis and liver failure, another hazard of obesity. An increase in osteoarthritis with resultant immobility and joint replacement yet another huge drain on the health budget. Then there is sleep apnea and the attendant day time sleepiness, accidents when in charge of cars and machinery. Diagnosis is expensive and treatment necessitates expensive breathing apparatus. Obesity is associated with low mood and depression.

A reduction in obesity has many advocates. Prof Dame Sally Davis in her final report when stepping down from her position as Chief Medical officer for England made strong recommendations to halve childhood obesity by 2030 [6]. Currently in the last year of primary school, out of a class of 30 children, 6 children are obese and a further 4 are overweight, twice as many as thirty years ago. She goes on to reiterate that we know that "our children have a right to live in a healthy environment". Being overweight or obese in childhood has profound impacts on the health and life chances of children. Children living in the most deprived areas are disproportionately affected.

Our environment has slowly changed making it harder for our children to be healthy. Today's children are drowning in a flood of unhealthy food and drink options compounded by insufficient exercise opportunities. Prof Davis goes on to describe the creation of health 'super zones' around schools that create safe spaces where children can walk and cycle to school, limit the sale of fast food and restrict unhealthy food advertising. Rotten teeth, mainly caused by excess sugar in food and drink, are now the most common reason for a child to be admitted to hospital. To days children are tomorrows work force and the parents of future generations. Their health will be the deciding factor in whether the UK is healthy and prosperous in the future Prof Davis writes [6].

An editorial in the *Lancet* [7] reiterates what is wrong in the environment that leads to childhood obesity. Too few children have access to affordable healthy food. Shops and many public places are flooded with heavily promoted unhealthy food and drink. Advertising and sponsorship places less healthy foods centre stage in young minds and urban streets are dominated by traffic with too few opportunities to walk to school, to ride a bicycle or simply to play and explore. Children who grow up in deprived neighborhoods are disproportionately affected [8]. There is good evidence that the rise in obesity is primarily environmental in origin and interventions are possible and of proven worth [9]. Prevention of obesity by better planning of the environment where children grow up, and exposure to daily physical exercise in schools and homes an essential component of a healthy life strategy.

When does obesity first start.? Prevention should be targeted to those obese children who are likely to remain obese in adulthood. Changes in overweight from childhood to early adulthood was examined by Bjerregaard., *et al* [10]. They looked at 62000 Danish men. They found that overweight at 7 years of age but normal weight at 13 was not associated with overweight in adulthood. Overweight at 13 and both overweight and normal weight at 7 was associated with overweight in adulthood. Thus, it would seem that there is a window between 7 and 13 in which to normalise weight, with the evidence that normal weight 13 year old's remain normal weight in early adulthood. Overweight men had an increased risk of having diabetes but also those who were overweight at 13 and normal weigh in adulthood had an increased risk of diabetes but lower than those who had persistent overweight. Lifestyle interventions that are aimed at weight loss in adults have been found to delay the onset of diabetes [11,12].

Children's independent mobility (CIM) is an important contributor to physical activity and health in children [13]. CIM has significantly reduced in the last 20 years. A systematic review by Marzi., *et al.* [14] of social and physical environmental correlates of independent mobility in children found that the social environment seemed to be more influential for ensuring CIM than the physical environment. Important neighborhood social environmental factors, influencing CIM, included car ownership, distance from school and neighborhood design.

CIM was examined by Stone., *et al* [15]. They found that children who were granted at least some independent mobility had more positive physical activity. CIM seemed to matter more in urban areas for boys and suburban areas for girls. Associations of built environment and children's physical activity was examined by Massumi [16]. Distance to school was a major driver of inactivity. Other areas in the literature suggested, 1. Different types of urban forms and land use such as urban, suburban, high density etc. 2. Different city sizes. 3. Different cultures. 4. Associations between mobility patterns of parents and their children, all to be relevant.

Social and environmental factors are known to influence many aspects of health including CIM, obesity and smoking. For example, Pacilli., *et al.* [17] describe antecedents and consequences of independent mobility in a group of 11 - 13 year old Italian children. They found that lower independent mobility predicted greater feelings of loneliness, a lower sense of safety and less frequent social activities with friends. They found that independent mobility changed according to different configuration of parenting styles.

The social contagion theory is well described by Christakis., *et al* [18]. The spread of Obesity in a large social network was examined by Christakis and Fowler [19]. They looked at the possibility of person to person spread of obesity as a factor contributing to the obesity epidemic. Using Framingham data collected over 32 years, discernible clusters of obese persons were present in the network at all time points. The clusters did not appear to be solely attributable to the selective formation of social ties among obese persons. A person's chances of becoming obese increased by 57% if she or a friend became obese in a given interval. The authors concluded that network phenomena appear to become relevant to the biological and behavioral trait of obesity and obesity appears to spread through social ties. Though the article gained a lot of interest and support it was roundly criticised by Cohen-Cole and Fletcher [20] who suggested that the reporting of Christakis and Fowler suggested that being fat remains a signifier of moral and physical decay. They suggest that the statistical approach is flawed.

Diabetes is a major health hazard leading to reduced life expectancy through damage to both large and small arteries. Diabetes thus takes up a very large part of health budgets. Diabetes impacts on lifetime work and productivity and presents a huge economic burden on societies. WHO [21] estimates that the number of people with diabetes worldwide rose from 108 million in 1980 to 422 million in 2014. WHO envisages metabolic disorders will be a major cause of death by 2030 and12% of global health expenditures are already estimated to be spent on diabetes [22,23]. The prevalence has increased more rapidly in middle and low income countries and in those who are socially deprived. Type 2 diabetes makes up 90% of all cases of diabetes. It used to be a disease of old age and less frequently found in middle age but now childhood Type 2 diabetes is not uncommon. Decreasing energy expenditure and increasing energy intake seem to be major driving forces but there are many other elements to this global increase [24]. The article explains how global nutrition transition, which embraces major changes in how food is produced, distributed and consumed, plays an important role in the rise in obesity and diabetes. The balance between metabolic capacity, i.e. the amount of excess food a person can tolerate and metabolic load is lost when the load exceeds the capacity and then healthy metabolism fails. Wells [24] suggests that efforts to curb the metabolic load must remain at the forefront of diabetes prevention. The metabolic capacity is probably set in the genes and the suggestion is that a low metabolic capacity is associated with survival in times of food deprivation, would have advantage. Birth weight is a driver of diabetes and obesity. A study in the nineteen sixties showed how starvation in the first trimester of pregnancy is associated with low adult weight and starvation in the third trimester associated with overweight in young adulthood. A later study on the same population showed that, in particular, famine in the third trimester is linked to decreased glucose tolerance in adults and sets the stage for diabetes [25]. Undernutrition, but also overnutrition in pregnancy are associated with an excess risk of diabetes in middle age [26-28].

Maternal diabetes predisposes the infant to diabetes later in life. Diabetes is associated with larger babies who have more adiposity and an increased risk of diabetes in adulthood [29]. Maternal obesity pre pregnancy is also associated with increased risk of diabetes to the child in later years [30].

An article by Sargis and Simmons [31] examines the place of chemicals in the rapid increase in diabetes. Environmental toxicants acting as endocrine disrupting chemicals have emerged as novel metabolic disease factors (EDCs). These include arsenic, biphenyls and organo-chlorine pesticides. The evidence in animal studies compelling but human studies are in their infancy.

Population increase and the environment

Human population has increased exponentially from less than 1 billion in 1800 to 5.5 billion in 1980 writes Anderson [32]. The dire consequences of human overpopulation were much discussed in the eighties and coincided with research efforts in the contraception field. That changed when it was predicted that the population of the world would stabilise by the middle of this century. It was not predicted then or at least accepted that greenhouse gases increase would create such a dangerous scenario produced by human activity, the increase leading to climate change and global warming. Waste from mega cities and widespread agricultural and livestock industries pollute air, water and land. Rapid depletion of resources from forests and oceans is destroying natural habitats and further contributing

to climate change, writes Dr Anderson. Currently there are 7.7 billion people on the earth and the UN predicts 9 billion will be reached by 2050. This on a background of less productive farming practices to reduce pollution. It is estimated that 40% of pregnancies are unintended. A disproportionate number of unintended pregnancies occur in young unmarried women who often lack access to comprehensive sexuality education and modern contraception [32]. The WHO has pointed out that unplanned pregnancies in the above group are a major contributor to maternal and child mortality and intergeneration cycles of poverty and poor health [33]. Globally the health costs attributable to pollution and global warming are projected to exceed $1 trillion per year (universal ecological fund). The economic case for climate action in the United States 2018 is beyond doubt [34]. Dr Anderson calls for a new contraception initiative as a way to help rebalance the planet and preserve its natural treasures for future generations.

Heat waves are much in the news with the terrible fires in Australia. Heat waves are a source of increased deaths and cardiovascular events. Even without fire, heat waves are the source of an increase in deaths and cardiovascular events [35]. They are also the source of more suicides. People living alone are particularly at risk. In the heat wave in France in 2003, 90% of the people who died lived alone. New building should be designed for future heatwaves rather than relying on cooling systems that require electricity or other fossil fuel-derived power that will only increase the rate of climate change [36].

Chronic kidney disease of unknown origin is a relatively new disease. First described in El Salvador almost 20 years ago and now is known to be common in hot humid regions of central America. The disease is now recognised in South America, the United States, the Middle East and India. In Central America chronic Kidney disease has become a leading cause of hospitalisation and death owing in large part to chronic kidney disease of unknown origin. The disease is related to heat exposure and dehydration. It is thought that the disease has become so common because of the rapid environmental change with the large increase in heat waves accompanied by increased humidity with direct impact on health [37]. A leading article in the New England journal of Medicine states "We are now living in an era when climate change is no longer a distant threat. It is happening now and is affecting Human health in profound ways" [38]. An additional 125 million adults were exposed to heat waves between 2000 and 2016 it is estimated [39].

Air pollution is one of the most obvious results of fossil fuel use. Short term exposure to air pollution causes severe lung damage, cardiovascular damage and is a major health concern. The association between short term air pollution and mortality is very well documented. A multinational, multi city, multi country assessment of weather or climate on mortality has recently been published. The study found that both large (10 um) and small (2.5 um) inhaled particles, showed associations to all cause cardiovascular and respiratory mortality in more than 600 cities across the globe [40]. The study showed that even low levels of pollution are a health hazard. The long-term health hazards of air pollution are of course also well documented [41]. The American Lung Association's State of the Air report 2019 [42] states that more than 40% of Americans live in areas with unhealthy levels of ozone and particulate matter. This, even though there has been a reduction in emissions of common pollutants since the 1980ies. Wild fires and heatwaves in parts of the country most affected by climate change have driven record breaking levels of pollutants in some of the most densely populated cities [43]. This has an important impact on chronic obstructive airways (COPD) which is a leading cause of death, indeed the 5th most common cause of death. The Editorial makes the point that COPD begins in childhood and adolescence when lungs are still developing.

Pollution from cows due to methane gas production has been much discussed in Ireland. On the other side of the coin the inefficiency of producing food by grazing cattle and then feeding in barns is very considerable when designing ways to improve food production efficiency. Methane contributes to global warming and also to tropospheric ozone formation [44]. Meat production does not only affect the ecosystem by production of gases but has a direct effect on global fresh water use, change in land use, and ocean acidification [45,46]. The health-related costs directly attributable to the consumption of red or processed meat will be 285 billion US$ in 2020. 4.4% of all deaths worldwide would be caused by red or processed meat. The Lancet article goes on to suggest that this mathematical model should be taken with a pinch of salt but it does follow on from 2015 WHO classification of some meats as proven carcinogens and the known effect

of saturated fat on cholesterol and the development of atherosclerosis [47]. The article ends by suggesting that there is very little benefit from eating red or processed meat for both the planet and the individual.

Carbohydrates have got a bad name because one of the class, refined sugar (sucrose) has been identified with obesity due to sugar laden drinks and as a cause of dental caries. However, the bulk of the family of carbohydrates are unrefined and are the principle source of energy and in the place of saturated fat are cardioprotective. An article by Reynolds., *et al.* [48] examined carbohydrate quality and health. In a meta analysis they found that both fibre and whole grains were complementary and a dose response curve was noted in the beneficial effect of both in terms of cardiovascular prevention, Type 2 diabetes, and breast and colorectal cancer. Refined grains with high glycaemic index, a measure of rapidity of absorption and insulin stimulation, showed smaller or no benefit. An article by Lucas and Horton [49] suggests a civilisation in crisis. "We can no longer feed our population a healthy diet while balancing planetary resources". They go on to state that the dominant diets the world has been producing and eating for the past 50 years are no longer nutritionally optimal, are a major contributor to climate change, and are accelerating erosion of natural biodiversity. The EAT-Lancet commission suggests that we need a 50% cut in meat consumption and an overall 100% plus increase in legumes, nuts, fruit and vegetables [50,51]. The human cost of our faulty food system Lucas and Horton go on to write, is that almost 1 billion people are hungry and almost 2 billion are eating too much of the wrong food. They end by stating that the nature that is disappearing holds the key to human and planetary survival. It is disappointing to read that in 2017 there was an increase in the people with hunger. State of food security and nutrition in the world report [52].

The Lancet Commission report 'The global syndemic of obesity, undernutrition, and climate change" was published in February 2019 [53]. Climate change can be considered a pandemic because of its sweeping effects on the health of humans and the natural systems we depend on (i.e. planetary health). These three pandemics, obesity, undernutrition and climate change represent the global syndemic that effects most people in every country and region worldwide. The authors suggest that the major drivers of the global syndemic are food and agriculture, transportation, urban design, and land use. Climate change is predicted or already has effects on food insecurity and undernutrition in many low and middle income countries due to crop failures, reduced food production, extreme weather events that produce droughts and flooding, increased food-borne and other infectious diseases, and civil unrest. Wealthy countries have the highest burden of obesity and largest carbon footprints but countries transitioning to higher incomes are shifting to lower physical activity , higher obesity and greenhouse gas emissions, the authors write; "Policy inertia is identified as the major cause of lack in progress to tackle the known causes and actions to reverse the Syndemic". A fundamental reorientation of food systems is necessary in particular, moving away from red meat and processed food. But the power of the large industrial food manufacturers and suppliers with large transnational political power is identified as a major hurdle to overcome. Re-directing food subsidies is one important goal the Commission identifies. In Ireland we have the problem of the subsidies paid to farmers to produce beef and on top of that the inheritance tax saving incentive for the wealthy to buy farms that they can pass on to their children who after 5 years of 'farming' with at minimum a qualified manager can sell the farm and avoid inheritance tax. A driver of more costly land. Transformation of the food systems should be based on the principle that food systems must promote health, environmental sustainability, social and health equity, and economic prosperity.

The Commission report is encouraging in that the treatment of the Syndemic is well known and clearly stated by many publications. The treatment is affordable. The political will needs encouragement. The financial support of low and middle income countries is feasible and the high income countries will be rewarded by better health, more productivity and lower health care costs.

Conclusion

Diabetes is being driven in part by human behaviour. Our behaviour is no longer sustainable and is leading to poor health outcomes. The treatment is available but the political leadership has yet to appear. The population globally is increasing at a rate that is not sustainable. This increase is amenable to change through education and availability of contraception and 'Morning after' treatment.

The money is available to ease the burden on low and middle income countries. The high income countries will also benefit by change.

The children already know that change must come now. The adults are dragging their feet. We owe it to our children and their children to change now. Now is the time to insist on a better approach to treat the syndemic.

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