

Declan Waugh BSc. CEnv. MCIWEM. MIEMA

In the light of recent scientific evidence demonstrating that fluoride is a risk factor in both the development of obesity and diabetes, it is critically important to consider the wider medical implications of water fluoridation using silicofluoride industrial chemicals for all relevant diseases including obesity, diabetes and cancer.

According to a major new study¹ by State-funded health promotion group Safefood, the obesity epidemic in Ireland is costing the State over €1.1 billion in direct health costs and indirect costs such as absenteeism. This is the first time researchers have put a price tag on the cost of obesity in Ireland. The report highlights that the direct cost of treating people who are obese and overweight is almost €400 million annually. Indirect costs, in the form of illnesses, absenteeism and premature deaths, account for the remaining €700 million. Yet it is accepted that these costs are themselves conservative as they do not allow for mental health costs made conservative assumptions about the number of years of life lost due to weight-related problems. Given that the prevalence of obesity is dramatically increasing in both children and adults the costs society and the economy in future years will be significantly higher.

In regard to obesity, the subject of the Safefood report, it is now accepted that high fat feeding and obesity induce endoplasmic reticulum (ER) stress in liver, which suppresses insulin production and contributes to diabetes.²

Recent research³ by the Russian Academy of Sciences presented clear evidence that fluoride also induces endoplasmic reticulum (ER) stress. The endoplasmic reticulum (ER) is a cellular compartment responsible for multiple important cellular functions including the biosynthesis and folding of newly synthesized proteins destined for secretion, such as insulin.

Accumulating evidence suggests that ER stress plays a role in the pathogenesis of diabetes, contributing to pancreatic β -cell loss and insulin resistance. ER stress has also importantly been linked obesity and insulin resistance in type 2 diabetes.⁴ Disturbances in the normal functions of the ER lead to cell death if ER dysfunction is severe or prolonged. Important roles for ER-initiated cell death pathways have been recognized for several other diseases, including hypoxia, ischemia/reperfusion injury, neuro-degeneration, heart disease, and diabetes.⁵

¹ The cost of overweight and obesity on the island of Ireland, Safefood November 2012, ISBN: 978-1-905767-335

² Décio L. Eizirik, Alessandra K. Cardozo and Miriam Cnop, The Role for Endoplasmic Reticulum Stress in Diabetes Mellitus, *Endocrine Reviews February 1, 2008 vol. 29 no. 1 42-61*

³ Natalia Ivanovna Agalakova and Gennadii Petrovich Gusev, *Sechenov Institute of Evolutionary Physiology and Biochemistry Russian Academy of Sciences*, Molecular Mechanisms of Cytotoxicity and Apoptosis Induced by Inorganic Fluoride, International Scholarly Research Network ISRN Cell Biology Volume 2012, Article ID 403835, 16 pages doi:10.5402/2012/403835

⁴ Muthuswamy Balasubramanyam, Raji Lenin and Finny Monickaraj, Endoplasmic Reticulum Stress In Diabetes: New Insights Of Clinical Relevance, *Indian Journal of Clinical Biochemistry, 2010 / 25 (2) 111-118*,

⁵ Xu C, Bailly-Maitre B, Reed JC. Endoplasmic reticulum stress: cell life and death decisions. *J Clin Invest.* 2005 Oct;115(10):2656-64.

Further studies have shown that fluoride exposure may contribute to impaired glucose tolerance or increased blood glucose.^{6,7,8} Researchers Menoyo et al.⁹ and Lin et al.¹⁰ demonstrated the effect of fluoride on glucose metabolism using in vivo and in vitro experimental models and confirmed that biologically relevant doses of fluoride result in impairment of an oral glucose tolerance test and decreased insulin synthesis.

It has also been reported that fluoride exposure regulates insulin gene expression in murine beta pancreatic cells, resulting in reduced insulin secretion.¹¹ Fluoride exposure has also been implicated in inflammatory response of the immune system including vascular inflammation and atherosclerosis (hardening of the arteries).¹²

It is known that the dietary exposure of the Irish population is high due to the consumption of fluoridated water, tea and the number of bottle fed babies fed formula milk made from fluoridated water in addition to other dietary sources of fluoride such as fluoridated toothpaste and fluoride based pharmaceutical drugs. It is particularly relevant to note therefore that the countries globally with the highest incidence of obesity are also those that practice artificial fluoridation of drinking water supplies. The prevalence of obesity in the U.S is 35% for males and 36% for females, in Canada 37% for males and 23% for females, Australia 35.6% for males and 21% for females, New Zealand 25% for males and 26% for females.¹³ When one examines statistics within fluoridated countries such as the U.S. it is equally interesting to discover that the Hawaii the state with the lowest incidence of water fluoridation also has the lowest incidence of dental fluorosis, the second lowest incidence of obesity next to Alaska and is also ranked in the lowest states for diabetes and asthma, a disease characterised by inflammation of the airways.¹⁴ The statistics for diabetes are particularly interesting as native Hawaiians have more than twice the rate of diabetes as Whites. The percentage of adult Whites/Asian over the age of 18 diagnosed with diabetes in Hawaii is 1.2% compared to the National average for the general public in the U.S.A of 7%.¹⁵

⁶ E.A. Garcia-Montalvo, H. Reyes-Perez, L.M. Del Razo, Fluoride exposure impairs glucose tolerance via decreased insulin expression and oxidative stress, *Toxicology* 263 (2009) 75–83.

⁷ A. Rigalli, J.C. Ballina, R.C. Puche, Bone mass increase and glucose tolerance in rats chronically treated with sodium fluoride, *Bone Miner.* 16 (1992) 101–108.

⁸ O. Barbier et al. Molecular mechanisms of fluoride toxicity, *Chemico-Biological Interactions* 188 (2010) 319–333

⁹ I. Menoyo, A. Rigalli, R.C. Puche, Effect of fluoride on the secretion of insulin in the rat, *Arzneimittelforschung* 55 (2005) 455–460.

¹⁰ B.J. Lin, M.J. Henderson, B.B. Levine, B.R. Nagy, E.M. Nagy, Effects of iodoacetate and fluoride on islate respiration and insulin biosynthesis, *Horm. Metab. Res.* 8 (1976) 353–358.

¹¹ E.A. Garcia-Montalvo, H. Reyes-Perez, L.M. Del Razo, Fluoride exposure impairs glucose tolerance via decreased insulin expression and oxidative stress, *Toxicology* 263 (2009) 75–83.

¹² O. Barbier et al. Molecular mechanisms of fluoride toxicity, *Chemico-Biological Interactions* 188 (2010) 319–333

¹³ International Obesity Taskforce, *Obesity Worldwide 2008-2010*.

¹⁴ U.S. Department for Health and Human Services, *Agency for Healthcare Research and Quality*

¹⁵ CDC 2012. *Summary Health Statistics for U.S. Adults: 2010*

In Ireland, based on the findings from the 2008-10 National Adult Nutrition Survey (NANS), estimated prevalence of overweight in adults is 37%, with a further 24% meeting current body mass index (BMI) criteria for obesity with 26% for males and 21% for females documented as obese. The prevalence of obesity in 18-64 year old adults has increased significantly between 1990 and 2011, from 8% to 26% in men, and from 13% to 21% in women, with the greatest increase observed in men aged 51-64 years.¹⁶ Notwithstanding other lifestyle and dietary factors this is also the latter sub group represents individuals with the highest lifetime exposure to fluoride in the Republic of Ireland since commencement of artificial fluoridation in mid 1960's. It is also worth noting that figures for obesity in Ireland are considerable above the EU average.

Singapore is the only other international country with a mandatory national legislative policy for water fluoridation and while the optimum level of fluoride in drinking water in Singapore is approximately half that recommended in Ireland the prevalence of obesity in Singapore is also remarkable high (16.9%) with approximately 24% of the Malaysian ethnic population obese and 17% of the Indian population.¹⁷ This is extremely high in comparison to Japan where 4% of the population are obese, the incidence for India is less 2%¹⁸, while in Indonesian less than 10% of men are classified as obese.¹⁹

How does this equate to a country such as Mexico which has a obesity levels similar to the U.S.A and yet does not fluoridate drinking water. Well on closer examination it is evident that Mexico has not pursued a policy of fluoridation of water for reasons of natural elevated fluoride levels already being present in water. This is particularly evident in the fact that Mexico has one highest incidences of dental fluorosis in the world, yet mass fluoridation of salt is mandatory. Government policy provides for 250 mg of fluoride to added to each kilogram of salt destined for human consumption (*table salt, cooking salt, breads and bakery products, processed foods, etc.*). The current consumption of fluoridated salt per person – child or adult – is estimated at 7.14g per day²⁰ bringing the fluoride dietary intake from salt alone to 1.85mg similar to the dietary intake from consuming artificially fluoridated water. This may help explain the incidence of obesity in Mexico which stands at over 30% of the population, a level comparable to the USA.

Other Latin American countries with extremely high prevalence of obesity include Argentina. In Argentina extremely high fluoride levels have been recorded in groundwater with large sectors of the population exposed to very high levels of fluoride. A survey undertaken in 2003 found that less than 3% of groundwater samples had fluoride levels less than 1.5mg/l

¹⁶ The cost of overweight and obesity on the island of Ireland, Safefood November 2012, ISBN: 978-1-905767-335

¹⁷ Obesity In Singapore, Prevention And Control, The Singapore Family Physician, Vol 38 No 1 Jan-Mar 2012:8

¹⁸ Obesity Update OECD 2012

¹⁹ Obesity Trends, Determinants and Policy Implications in Indonesia, 2012

²⁰ Fluoride Class Action (<http://fluoride-class-action.com/districts/mexico>)

with fluoride concentrations ranging from 0.9–18.2 mg l⁻¹, with a mean value of 3.8 mg l⁻¹.²¹ In addition to naturally elevated fluoride levels artificial fluoridation is practiced in parts of the country where approximately 20% of the population consume artificially fluoridated drinking water. It is not surprising therefore to find that Argentina has the highest incidence of obesity and overweight children in Latin America.²²

Last but not least another interesting country to examine is Saudi Arabia. Why has this desert climate such a high prevalence of obesity and diabetes? The prevalence of obesity in Saudi Arabia is recorded²³ at 36.9% which is extremely high for such a hot climate. The incidence of diabetes is recorded²⁴ at 16.21%. As with Mexico and Argentina extremely high fluoride levels of up to 6.2mg/L are reported in drinking water in Saudi Arabia.²⁵ In the Hail region of Saudi Arabia it has been documented that up to 90% of children have dental fluorosis. This is associated with the high levels of fluoride 0.5-2.8mg/l found in well water in this area.²⁶ The city of Mecca with fluoride levels of 2.4mg/l is also known to have endemic fluorosis.²⁷

It is no surprise therefore where fluoride is a risk factor in both diabetes and obesity to see such a high incidence of both such diseases in countries where water fluoridation may not be practiced but where the resident populations are exposed to dietary fluoride levels similar if not higher than in fluoridated North America, Canada, Australia, New Zealand or Ireland.

The world prevalence of diabetes among adults (aged 20-79 years) will be 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7 % and 439 million adults by 2030.²⁸

Diabetes is a condition in which the amount of glucose in the blood is too high because the body is unable to use it properly. Normally, the amount of glucose is carefully controlled by the hormone insulin, which is produced in the pancreas. Diabetes mellitus is now considered to be the leading public health problem in all developed countries. It is now estimated that there are in excess of 200 million people with diabetes mellitus worldwide and is predicted to reach 333 million by 2025.

As previously identified fluoride has been found to act as an inhibitor of insulin synthesis. In Ireland, it is estimated that there are 200,000 people with diabetes and a further 200,000 who

²¹ WHO Fluoride in Drinking Water, 2006.

²² Centre of Studies on Child Nutrition (CESNI) Oct 2012.

²³ Al-Nozha MM et al. Obesity in Saudi Arabia. Saudi Med J. 2005 May;26(5):824-9.

²⁴ International Diabetes Federation 2011

²⁵ Aldosari AM, Akpata ES, Khan N, Wyne AH, Al-Meheithif A. Fluoride levels in drinking water in the Central Province of Saudi Arabia. Ann Saudi Med. 2003 Jan-Mar;23(1-2):20-3.

²⁶ Akpata et al. Dental Fluorosis in 12-15yr old rural children exposed to fluorides from well drinking water in the Hail Region of Saudi Arabia, Community Dentistry and Oral Epidemiology 1997, 25(4) 324-327.

²⁷ Al-Khateeb et al Caries prevalence and treatment among children in Arabian community, Community Dentistry and Oral Epidemiology 1991, 19, 277-280.

²⁸ Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Res Clin Pract. 2010 Jan;87(1):4-14. Epub 2009 Nov 6.

have diabetes but are unaware that they have the condition. The majority of these people will only be diagnosed through an acute medical event or the complications of long term untreated hyperglycaemia. A further 250,000 people have impaired glucose tolerance or "pre-diabetes" of which 50% will develop diabetes in the next 5 years if lifestyle changes are not made.²⁹

Type I (insulin dependent) diabetes is increasing in children, particularly in under-fives while Type 2 (non-insulin dependent) diabetes is increasing across all age groups. In Ireland, the incidence of type 1 diabetes is 16.8 per 100,000, which is above the European average.³⁰ The prevalence of diabetes in Ireland is now at 6.1 per cent of the population however it is accepted that this figure is an underestimation as it does not include those that have diabetes but are unaware they have the condition. The prevalence of diabetes in non fluoridated Northern Ireland is 3.8 per cent of the population, while the UK average is 4.45%.³¹

The prevalence of diabetes internationally is similar in pattern to that for obesity with typically greater prevalence being found in either naturally high or artificially fluoridated countries. The prevalence for Canada is 10.8%, United States 10.98%, Israel 8.5%, Mexico 15.9%, New Zealand 10.2%, Singapore 11.1 per cent.³² As noted earlier the prevalence for Ireland is above the EU average, including twice that recorded for non fluoridated Northern Ireland.

The economic burden of diabetes on the Irish health care system is now as with obesity a major challenge for the government and the HSE. Prof. J. Nolan's **CODEIRE** study³³ published in 2006, which examined the cost of treating type 2 diabetes in Nov-Dec 1999, suggested that 10% of the national health budget is being consumed treating the condition (49% on hospitalisation for complications and wages; 42% on drug costs; 8-9% on ambulatory care and attending non-diabetes specialists for diabetes related complications). **CODEIRE** remains the best available Irish source for the cost of type 2 diabetes. In 2011 the national health budget was €14.5 billion. Taken together both diabetes and obesity account for almost €2 billion of the Health Budget for the HSE. This figure is just the direct costs to the State. If you add the indirect costs the final figure is over € 4 billion. Not taking the contribution of fluoride to cancer diseases or other medical ailments such as musculoskeletal pain, periodontal disease, skin disorders, thyroid disorders and neurological problems, the true cost of artificial fluoridation on public health and the economy is staggering. This shows that water fluoridation is not just an issue of preventing dental decay; it is also an issue of reducing risk factors that are now known to be contributing to a deepening health crisis with catastrophic economic and social costs.

²⁹ Diabetes Federation of Ireland

³⁰ Diabetes: The Policy Puzzle, Is Europe Making Progress? The International Diabetes Federation (2012).

³¹ Diabetes UK

³² International Diabetes Federation 2011.

³³ Nolan JJ, O'Halloran D, McKenna TJ, Firth R, Redmond S. The cost of treating type 2 diabetes (CODEIRE). *Ir Med J.* 2006 Nov-Dec;99(10):307-10.