

Review Article

Point of View — Diabetes & Cardiovascular Disease in Rural India : A Hidden Link ?

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There is a worrying increase in Diabetes and Cardiovascular Diseases in Rural India. Most of the research in India is focussed on diet, lifestyle and traditional risk factors. Anecdotally, we see a lot of farmers from rural areas with minimal history of traditional risk factors but Florid Diabetes and Vascular Disease. We believe that Agrochemicals and Diabetes is a “hidden link” that has been largely unexplored in the Indian subcontinent. Studies focussed on environmental endocrine disruptors, especially pesticides and heavy metals is the need of the hour in rural Indian populations. Such studies will help in solidifying a causative link, improve rural healthcare, inform Governmental Regulatory Agencies on safer policies and reduce rural disease burden.

[J Indian Med Assoc 2021; 119(11): 42-3]

Key words : Diabetes, Cardiovascular Disease.

South Asia, particularly India, home to around 18% of the World's Population, is currently in the midst of an epidemiological transition from infectious and nutritional illness to Non Communicable Disease (NCDs), especially Cardiovascular Disease, predominantly driven by a cluster of “traditional risk factors” like Diabetes, Pre-diabetes, Obesity, Diet & Lifestyle, hypertension, hyperlipidaemia and atherosclerosis. Individually, each of the above risk factors has huge healthcare, economical and societal implications. Collectively, this “Axis of evil” is a disaster in the making for India and a “ticking time bomb” that will wreak the Nation's Health.

An important driver in the huge explosion of Diabetes and Hypertension in India has been the changes in diet, lifestyle and physical activity. In fact, poor physical activity and unhealthy diets have emerged as the two most important modifiable risk factors for prevention of Diabetes and Cardiovascular disease¹. In one of the largest scientific study in India looking at physical activity in different regions, nearly half of the population in four different regions of India were inactive. This translates to 392 million inactive individuals in India! Even among those who spent time in recreational physical activity, the overall duration of moderate to vigorous physical activity was less than twenty minutes per day². Coupled with the choice of unhealthy foods, this sets the platform for an ‘Obesogenic environment’ that has huge implications for the burden of Non-communicable Diseases in India. Indians have a propensity to have a higher content of visceral fat for a similar Body Mass Index (BMI),

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Received on : 24/03/2020

Accepted on : 16/06/2020

Editor's Comment :

- The epidemiological transition from Infectious to Non-Infectious Diseases like Diabetes and its complication has brought into focus the Non-traditional Factors involved in evolution of Diabetes.
- It is speculated that chronic exposure to pesticides in low dose, in the form of unwashed fruits and vegetables may lead to development of Insulin resistance and Diabetes gradually.
- Further studies in this matter may help in confirming this speculation.

compared to Caucasians, famously termed the “Y-Y Paradox”³. There is good evidence linking visceral fat to increased risks of Diabetes and Pre-diabetes. Therefore, even a minimal increase in weight can increase the visceral fat, which in turn translates to a higher risk of Diabetes and Cardiovascular diseases.

The concern for all healthcare professionals and policy makers is the fact that the transition in both the risk factors and Cardiovascular Diseases in India has occurred over a relatively short period of time⁴. To compound this, India is a “Nation within a Nation”, where many states have populations close to that of countries in Europe! Therefore, there will be huge regional variations in diseases and risk factors that will have a bearing on how scanty resources can be utilised to optimise healthcare. Our concern is primarily centred towards rural Indian population where the triple burden of lack of awareness, healthcare costs and poor healthcare facilities add significantly to morbidity and mortality from non-communicable diseases. The progression of this NCD epidemic, especially in rural areas, is characterised by a multitude of factors including rapid urbanisation, reversal of socioeconomic gradients, fast food culture, less intake of fruits and vegetables, tobacco and alcohol use/ abuse, less access to healthcare in the poorer socioeconomic strata of the society and much more. Efforts to understand the Pathophysiology of this transition has been traditionally

focussed on the above factors. However, there is growing body of evidence for the role of non-traditional risk factors, especially Pesticides, in the development of Diabetes, Pre-diabetes, Hypertension, atherosclerosis and cardiovascular disease.

Pesticides & Diabetes ?

Our interest in pesticides and diabetes was sparked by case of a fifteen-year-old girl with pesticide poisoning masquerading as Diabetic Ketoacidosis, a major Medical Emergency, Causing great uncertainty in treatment⁵. There have been several other case reports of organophosphorus poisoning presenting as Diabetic Ketoacidosis^{6,7}. In one of the cases, a young boy had apparently taken unwashed, pesticide sprayed tomatoes from a field and presented with diabetic ketoacidosis. His clinical condition deteriorated even though his metabolic parameters improved and the diagnosis was finally made with very low cholinesterase levels. Once the child (and our patient) received Atropine and Pralidoxime therapy, which are anti-dotes to organophosphates, he made a dramatic recovery and had no diabetes in a four week follow up. Therefore, OP poisoning may occasionally overwhelm Glucose Homeostatic Pathways in selected patients and present as Diabetic Ketoacidosis with potential for erroneous treatment. If Organophosphates in acute poisoning can cause severe hyperglycaemia, is it possible that long term exposure to pesticides in our rice, fruits and vegetables are a "cog in the wheel" for the Huge Diabetes Epidemic we see in our populations? Is it possible that farmers and rural subjects exposed to pesticide sprays and mixtures over a long period of time become Diabetogenic? This is a pertinent question as pesticide use is not only well entrenched but has dramatically increased with an estimated 5.2 billion pounds Worldwide use in 2006-7. There are different types of pesticides available but the ones that are widely used include the Organophosphates (OP), Organochlorines (OC) and Carbamate (CB). Newer pesticides including Nicotinoid pesticides and insect growth regulators are also finding their way into the market. OP's can be absorbed through intact skin and also from the gastro-intestinal tract after ingestion of contaminated food⁸. The vapours are also capable of penetrating the Skin, Cornea and the Respiratory Epithelium. Apart from Neuro and Cardio Toxicity, Organophosphates and Organochlorines seem to affect multiple pathways that affect Glucose Homeostasis, that collectively contribute to Hyperglycaemia⁹. This includes effects on Glycogenesis, Glycogenolysis, Glycolysis, Gluconeogenesis, Insulin expression, stress induced activation of Hypothalamic-Pituitary Adrenal axis (HPA), Autonomic Nervous System, Oxidative stress, Inhibition of Blood Paraoxonase Activity, Pancreatic inflammation, Adrenal

Gland Stimulation leading to Hyper Secretion of Adrenaline and alterations in metabolism of liver enzymes¹⁰.

Clinical Implications :

Pesticide use is highly settled in the World today, not only in agriculture but also in the urban settings (homes, workplace, outdoors) for termite and mosquito control. Not to be forgotten is the amount of low dose chronic exposure to pesticides in unwashed fruits and vegetables that we consume every day. A number of human studies and animal studies clearly suggest a signal in terms of acute and chronic pesticide exposure with the development of Insulin Resistance and Diabetes. Considering the Epidemic of Diabetes, it is always worthwhile to think about non-traditional factors in the Pathophysiology of Diabetes, especially in Rural India. Clearly the ubiquitous use of pesticides is an attractive "Diabetogenic Link". Studies focussed on those who are occupationally exposed to pesticides, especially farmers, may prove vital in clarifying a causative link. Such studies may play an important role in health promotion, preventive care, a shift in thought as well as Action by governmental regulatory agencies and importantly provoke new research so than products that are more "Metabolic Friendly" become easily available.

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