

Primordial prevention: The missing link in neurological care

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ABSTRACT

Stroke, and neurodegenerative diseases represents, a major and rapidly growing burden of mortality and morbidity. The risk factors for stroke starts very early in life. Similarly, the changes of neurodegenerative diseases starts decades earlier than the clinical manifestations. Primordial prevention is necessary to prevent the establishment of risk factors to keep the population disease free. This will help to not only increase the life span, but also to prolong the health span.

Keywords: Digital biomarkers, neurodegenerative disease, primordial prevention, stroke

Introduction

The proverb “Prevention is better than cure” is true even in the present scenario. Preventive measures for acute and chronic diseases is an integral part of medical practice and health care planning.

The goal of prevention is to ensure preserving quality of life, decreasing morbidity, and enabling one to enjoy a better life. Preventive strategies lays emphasis on extending the health span,^[1] and not just the lifespan.

Successful preventive strategies should be designed to have a double pronged approach:

1. Problem oriented: to address health loss due to aging, multiple medical co-morbidities, social, environmental, economic, climatic, behavioral, genetic, biological, and occupational factors.

2. Goal oriented: to seek newer windows of opportunities to help extend life, and ensure healthy life.

Population aging is one of the key factors in the rise of chronic neurological diseases.^[2] However the role of multiple transitions occurring simultaneously cannot be neglected.

Approximately 12% of death worldwide are due to neurological diseases according to the World Health Organization (WHO). More importantly, the morbidity and long term disability accounts to a loss of more than 92 million years of healthy life in 2005.^[3] Most of the premature deaths and long-term disabilities are largely preventable by enabling a robust chain of preventive measures.

The classification of preventive actions into Primary, Secondary, and Tertiary,^[4] proposed by Leavell and Clark has been already operational in medical and neurological practice to a great extent.

1. Primary prevention: implies measures to reduce the risk of disease among individuals with a risk factor. A risk factor is defined as “an individual attribute or exposure that is positively or negatively associated with the occurrence of a disease”. Some risk factors are modifiable, whereas some are nonmodifiable.

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Control of blood pressure, blood sugar, smoking and tobacco cessation, are primary preventive measures to prevent stroke and cardiovascular events, in individuals who have not yet experienced stroke, transient ischemic attack (TIA), or cardiovascular events.

2. Secondary prevention: implies measures to avoid disease recurrence in an individual already affected by the disease. The use of anti-platelet drugs or anti coagulants in the treatment of ischemic stroke is secondary prevention.
3. Tertiary prevention: implies measures to minimize the chronic effects of a health problem in an individual or population by reducing the resulting functional impairment. Rehabilitation of stroke patients by physiotherapy, speech therapy, is included as tertiary prevention.

Primordial Prevention

One of the fundamental changes in concept in recent times was the shift of preventive strategies to even earlier stages of the lifeline, to prevent establishment of a risk factor in a population, or to detect it before a risk profile is established.

Therefore the introduction of Primordial prevention. Primordial prevention^[5] is a recent concept which was first introduced in 1979. It emphasizes on the principle of risk factor development prevention; as it is difficult to restore risk factor to base level once it gets established. Although utopian, the ultimate means for reducing the burden of chronic diseases is Primordial prevention.

When and how to intervene in primordial prevention are vexing but critical questions.

The five stages of life course are: fetal development and maternal environment, infancy and childhood, adolescence, adulthood, and old age. Although distinct, they influence each other and subsequently impact the course of life.

Over the recent past, a concept has emerged which suggest that starting interventions very early-as early as infancy and perhaps before, in intrauterine life, may be an effective approach to prevent chronic diseases. The “first 1000 days” from conception to preschool ages are a period of maximal developmental plasticity. This is a critical and sensitive period, during which modification of relevant exposures has a potential of lasting impact on the health of an individual. Preventive interventions during this period, may thus set an individual on the best possible health trajectory in future.^[6]

Primordial prevention to prevent neurological disorders

Before birth (in- utero)

The Barker Hypothesis, which states diseases in later life can be due to under nutrition in utero, which leads to permanent changes in the body’s structure, physiology and metabolism. This is also sometimes referred to as “fetal programming of

chronic diseases”.^[7] Children born to mothers with malnutrition during gestation, have higher incidence of intrauterine growth retardation, metabolic disorders like insulin resistance, diabetes mellitus, hypertension, dyslipidemia, with increased risk of atherosclerosis. These risk factors lead to increased stroke and cardiovascular related mortality and morbidity.^[8] Therefore by controlling maternal malnutrition, risk of developing stroke, vascular dementia can be minimized.

Neural tube defects like spinal dysraphism can be due to Folate deficiency in early pregnancy. Studies have shown a reduction in the incidence of spinal malformation is possible by preconceptual folate supplementation.^[9]

Iodine deficiency is a well-recognized cause of intrauterine cerebral injury,^[10] and successful intervention has shown prevention of fetal neurological impairment.

Maternal alcohol ingestion increases the chance of neurological injury,^[11] causing Fetal alcohol syndrome. Fetal alcohol syndrome children have defects in frontal lobe, corpus callosum, cerebellum, hippocampus, basal ganglia, as shown by brain imaging studies. They can develop disconnection syndromes. Cocaine leads to fetal cerebral injury due to vasoconstrictor effect, resulting in cerebral infarction.^[12] It is unclear regarding the association of Cerebral Palsy with Opiate addiction, or associated circumstances. Primordial prevention strategies for preconceptual counseling and monitoring of maternal behavior and addiction can prevent these fatal outcomes in newborns.

Maternal drug use for treatment of epilepsy can cause fetal neurological injury. Fetal hydantoin syndrome occurs in about 10% of infants born to epileptic women treated with phenytoin.^[13] The abnormalities include facial and skeletal abnormalities, together with a small but significant cognitive impairment in children. Preconceptual counseling and change of anti-epileptic medication should be undertaken as primordial prevention.

Maternal infection, both bacterial and viral, is associated with increased risk of cerebral palsy in offsprings. Maternal infection can cause preterm delivery; and periventricular leucomalacia due to associated fetal infection.^[14] Prevention or treatment of bacterial infection has a potential role of preventing fetal neurological injury.

Primordial prevention strategies from infancy throughout childhood into adolescence

- (I) Healthy behavior and lifestyle:
 - (a) Healthy eating patterns: Counseling and monitoring, with emphasis on nutrient dense (rather than calorie dense) whole food, with more fruits, vegetables, whole grain, and less sodium. Baby foods should be monitored for lower sodium formula. Repeated advice on healthful diet during infancy and toddlerhood may lower later blood pressure and risk of stroke.

- (b) Physical activity: Parents and teachers should be advised to encourage physical activity in children. Children should be made to walk compulsorily a certain distance to and from school daily. A definite duration of about ten to fifteen minutes should be earmarked daily where the children stand and do gentle stretching. Even modest efforts at maintaining healthy physical daily from childhood can help to prevent development of chronic illness later in life.
- (c) Sleep hygiene: Sleep less than 7 hours is associated with adverse outcomes, associated with the development of risk factors for stroke, cerebrovascular events, mental, and cognitive impairment.^[15] Sleep hygiene should be started early in childhood with avoidance of television watching, and mobile phone use prior to sleep, or late into night.
- (d) Tobacco avoidance: A leading global cause of premature death is Tobacco. It accounts for 7% of all female, and 12% of all male deaths globally.^[16] Smoking prevention counseling should be started at 8 years of age, as a primordial preventive measure.
- (e) Accidents and injuries: A common cause of epilepsy in adolescents and adults is Head Trauma. Recurrent seizures can develop within 1 year of head trauma, although this can occur after an interval of 10 years also.^[17] Head trauma can cause subdural hematoma, which later can lead to dementia. Safety measures like seat belt use can prevent accidents, and avoid later occurrence of epilepsy and dementia.

Exposure to child abuse is a recognized risk factor for subsequent adoption of high risk behavior like smoking, alcohol and drug abuse, which in turn predispose to stroke and cerebrovascular diseases.

- (II) Environment: Air pollution is increasingly being recognized as a risk factor for many diseases, like stroke.^[18] Laws to reduce air pollution from industries, transportation, are necessary to provide the future generation an environment free from risk factors of chronic illness, as well as acute illness.
- (III) Socio economic transition: It has been seen paradoxically that in certain regions, economic prosperity brought about a higher risk of stroke.^[19] This is most probably that when money enters a previously impoverished area, it leads to irresponsible, and unhealthy behavior leading to risk of stroke. Therefore counseling for responsible use of wealth for themselves and their children is necessary to prevent the establishment of such risk factors.

Role of digital biomarkers in primordial prevention

A major and rapidly growing burden of morbidity and mortality are Neurodegenerative diseases, like Alzheimer's disease and Parkinson's disease. As the disease progress the likelihood of reversing the anatomic, physiologic, and pathological changes decrease dramatically. Therefore detection of the disease at the early or prodromal stage can offer a window of opportunity for successful intervention. Currently various biomarkers are used for neurodegenerative diseases. They include:

Neuropsychological/Cognitive tests: they take relatively long time to administer, are not able to detect subtle changes in the earliest stages of the disease, and suffer from intrinsic cultural bias.

Neuroimaging (MRI/PET): limited by high cost, and availability

Cerebrospinal fluid markers: limited by invasive nature of the tests

Therefore Digital Biomarkers^[20] comprising of various hardware and software, in the form of smart phones, digital watches, digital screens, digital keyboards, can be used for the Primordial prevention of neurodegenerative disorders.

Digital technology^[21] (precision medicine) is widely available, affordable, always accessible by patients and increasingly used, low burden on health care system, and less influenced by bias.

Digital Susceptibility/Risk Biomarker: are used for the detection of individuals currently not having clinically apparent disease, but having the potential for developing a disease or medical condition.

Active (prompted), or passive (unnoticed) measurements are made by on board sensors, which provide metrics for developing methods for disease monitoring, detection, and forecasting. Specific sensors and metrics like gross motor function, fine motor control, geopositioning, speech and language, oculomotor movement, papillary reflex, visual preference, eye blink rate, autonomic nervous system function parameters, are used to detect preclinical and early stage of neurodegenerative diseases.^[21]

Digital monitoring by wearables (smart watches, rings) can collect data through sensors the body's own information like counting steps, measuring heart rate. This can help to change one's behavior and encourage to lead a healthy life.

Conclusion

We must continue to build evidence base for primordial prevention and incorporate new technologies for better implementation.

Implementation of Preventive care:

Knowledge of preventive care and its implementation is necessary for primary care physicians, as they are the physicians of first contact to the population, and therefore they will have the means and access for its implementation in their respective areas.

Historically two approaches, the vertical and horizontal/integrated, approaches, have been debated from the point of view of their implementation. These approaches are however are not mutually exclusive, but complementary to each other. Therefore implementation in a combined manner will strengthen the chain of protection against various neurodegenerative and other noncommunicable diseases.

Key points

1. Preventive strategies is the key to address not only acute diseases, but also chronic neurodegenerative diseases.
2. Primordial prevention should be also implemented together with primary, secondary, and tertiary prevention, in a combined and integrated manner.
3. Newer technologies like Digital Biomarkers should be utilized for the successful implementation of Primordial prevention.

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References

1. Perak AM, Marino BS, de Ferranti SD. Squaring the curve of cardiovascular health from the beginning of life. *Pediatrics* 2018;141:e20172075.
2. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing population: The challenges ahead. *Lancet* 2009;374:1196-208.
3. Murray CJL, Lopez AD. The global burden of disease: A comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020. *Global Burden of Disease and Injury Series, Vol. 1*;1996.
4. Leavell H, Clark EG. *Medicina Preventive*. Sao Paulo: McGraw Hill do Brasil; 1976.
5. Matthew W, Gillman MD. Primordial prevention of cardiovascular disease. *Circulation* 2015;131:599-601.
6. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges, and interdisciplinary perspectives. *Int J Epidemiol* 2002;31:285-93.
7. Available from: <http://www.heart-resources.org/wp-content/uploads/2011/11/Fetal-health-and-NCDs-June-2011.pdf>.
8. Darnton-Hill I, Nishida C, James WPT. A life course approach to diet, nutrition, and the prevention of chronic disease. *Public Health Nutr* 2004;7:101-21.
9. Prevention of neural tube defects: Results of the Medical Research Council Vitamin Study. MRC Vitamin Study Research Group. *Lancet* 1991;338:131-7.
10. Pharoah POD, Hornabrook RH. Endemic cretinism of recent onset in New Guinea. *Lancet* 1974;2:1038-40.
11. Wright JT, Toplis PJ. Alcohol in pregnancy. *Br J Obstet Gynaecol* 1986;93:201-2.
12. Volpe J. Effect of cocaine use in fetus. *N Engl J Med* 1992;327:399-407.
13. Friedman JM, Hanson JW. *Clinical Teratology*. Emery and Rimoin's Principles and Practice of Medical Genetics. 2013.
14. Perlman JM, Risser R, Broyles RS. Bilateral cystic periventricular leukomalacia in the preterm infant: Associated risk factors. *Pediatrics* 1996;97 (6 Pt 1):822-7.
15. Irish LA, Kline CE, Gunn HE, Buysse DJ, Hall MH. The role of sleep hygiene in promoting public health: A review of empirical evidence. *Sleep Med Rev* 2015;22:23-36.
16. World Health Organization. *Global Status Report on Non communicable Diseases 2010*. Geneva: WHO.
17. Ferguson PL, Smith GM, Wannamaker BB, Thurman DJ, Pickelsimer EE, Selassie AW. A population-based study of the risk of epilepsy after hospitalization for traumatic brain injury. *Epilepsia* 2010;51:891-8.
18. Yin P, He G, Fan M, Chiu KY, Fan M, Liu C, *et al*. Particulate air pollution and mortality in 38 of China's largest cities: Time series analysis. *BMJ* 2017;356:j667.
19. Morgenstern LB, Kissela BM. Stroke disparities: Large global problem that must be addressed. *Stroke* 2015;46:3560-3.
20. Coravos A, Khozin S, Mandi KD. Developing and adopting safe and effective digital biomarkers to improve patient outcomes. *NPJ Digit Med* 2019;2:14.
21. Hussain M. Smart healthcare in neurology. *Adv Biomed Res* 2020;9:39.