



Yoga and Meditation: The Holistic Way to Decrease Incidence of Childhood Cancer

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Letter to Editor

Dear Editor,

Population-based Cancer Registries in India for the period of 2012-2014 have reported around 0.7 - 4.4% proportion of neoplasm in children (0-14 years) relative to cancers in all age groups. According to 2012-2014 consolidated report of Hospital-based Cancer Registries, specific types of cancers in childhood have been reported under the broad headings of leukemias, lymphomas & reticuloendothelial neoplasms, central nervous system & miscellaneous intracranial & intraspinal neoplasm, sympathetic nervous system tumours, retinoblastoma etc. with similar proportion among boys and girls [1]. Survival and health trajectory of an offspring depends on the integrity and stability of genomic information it receives as a zygote. Childhood cancers are assumed to be multifactorial and an increasing incidence is reported in children born to older fathers. Increase in childhood morbidity has been reported in children born to fathers with oxidative DNA damage in sperm genome [2]. The complex interplay of genetic and environmental factors, replication errors and transmission of genetic material in a multistage sequence, paternal preconception health and poor lifestyle factors contribute to accumulation of *denovo* germline mutations and epi-mutations and childhood cancers. Advanced paternal age and associated accumulation of replication associated errors, lifestyle-related factors (smoking, tobacco consumption, psychological stress, sedentary lifestyle, intake of nutritionally depleted processed food and hazardous occupational exposures) cause Oxidative Stress (OS) in the male germ line which may be common underlying aetiology of infertility, recurrent implantation failures, recurrent spontaneous abortions, preterm births, congenital malformations, complex neuropsychiatric disorders, obesity, metabolic syndrome, childhood cancers and imprinting disorders. Sperm is highly susceptible to oxidative damage due to presence of high content of polyunsaturated fatty acids, incompletely protaminated and poorly compacted nuclear DNA, limited anti-oxidants in the scant cytoplasm and a deficient DNA damage detection (lower *PARP* levels) and repair mechanism (lower *OGG1* levels). Hence, sperm accumulates mutations at a much higher rate than the oocyte and is dependent on the oocyte to remove oxidative DNA lesion which accumulate due to various exogenous/ endogenous factors and advanced paternal age. This is further compromised by advanced maternal age where the aging oocytes with an inefficient repair mechanism results in persistence of sperm oxidative DNA lesions. The zygote genome thus harbors higher mutations in turn results in increased risk of childhood cancers. These alterations result in molecular ageing due to disruption of sperm DNA integrity, reduced testicular functions, rapid telomeric attrition, mitochondrial dysfunction, pre oxidative damage to sperm plasma membrane microsatellite instability, aberrant methylation patterns (hypomethylation of oncogenes & hypermethylation of tumor suppressor genes), unmasking of repetitive elements, dysregulation in levels of mRNAs/transcripts and results in OS and chemical induced carcinogenesis as well as associated epigenetic disorders to the offspring [3].

Recent advances in technology, lack of space and time, food loaded with insecticides/pesticides and a highly stressful lifestyle has led to the disturbances in natural bio-chemical environment in the brain which affects primary gonads *via* Hypothalamic-Pituitary-Gonadal (HPG) axis [4]. The imbalances in mind, body and gonads leading to poor sperm structure and function can be reflected by supra-physiological ROS levels and lowering of levels of anti-oxidants. Highly stressful lifestyle, depression, anxiety reaching high levels is associated with raised cortisol and lower total antioxidant capacity and thus oxidative stress. Hence maintenance of this redox balance is of prime importance for the regulation of Hypothalamic-Pituitary-Gonadal (HPG) axis. In this age of super specialization we proposed that a simple lifestyle intervention including yoga and meditation will not only impact a particular system but impact the body as a whole, resulting in improvement of physical, mental, reproductive health. We propose that Yoga and Meditation based Lifestyle Intervention (YMLI)

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may actually aid in reducing the sequel of OS and testicular ageing and improving the health of offspring. YMLIs are an adjunct therapy to modern medicine as they maintain the equilibrium between ROS production and anti-oxidant scavenging activities, unlike the indiscriminate use of anti-oxidants which may result in reductive stress and impair various physiological processes.

Studies from our laboratory have reported that YMLI can reduce OS induced damage to paternal genome, improves sperm DNA integrity, regularize levels of sperm transcripts and hence can reduce the incidences of childhood cancers like retinoblastoma [5]. OS induced genome wide global hypomethylation and over expression of oncogenes, repetitive elements unmasking, imprinted genes, hypermethylation & reduced expression of tumor suppressor genes, apoptosis, cell cycle regulatory, cell differentiation and oxidative stress damages both mitochondrial and nuclear DNA damage. Mitochondrial DNA damage precedes nuclear DNA damage which results in excessive free radical production. We have documented a decline in seminal ROS levels within 10 days practice of yoga and meditation and gradual reduction of DNA damage and improvement in sperm DNA integrity over a period of 6 months. YMLI normalizes the levels of sperm transcripts, increased expression of genes involved in DNA repair, cell cycle checkpoint control and causes down regulation of pro-inflammatory genes [6-8]. YMLI aids in maintenance of genomic stability and chromosomal integrity, reducing the rate of cellular ageing by maintaining telomere length and upregulation of telomerase activity [9,10]. OS results from endogenous and exogenous factors. Majority of these factors are associated with unhealthy social and lifestyle habits and thus can be modified. YMLI is a technique and a science of inner well-being which impacts the body, mind as a whole and results in promoting health and improving quality of life. Reduction in OS, improvement in sperm DNA integrity may reduce genetic and epigenetic aberrations in the genome and thus reduce the risk of developing cancer in the offspring.

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