# Vital Link

The journal of the Canadian Association of Naturopathic Doctors

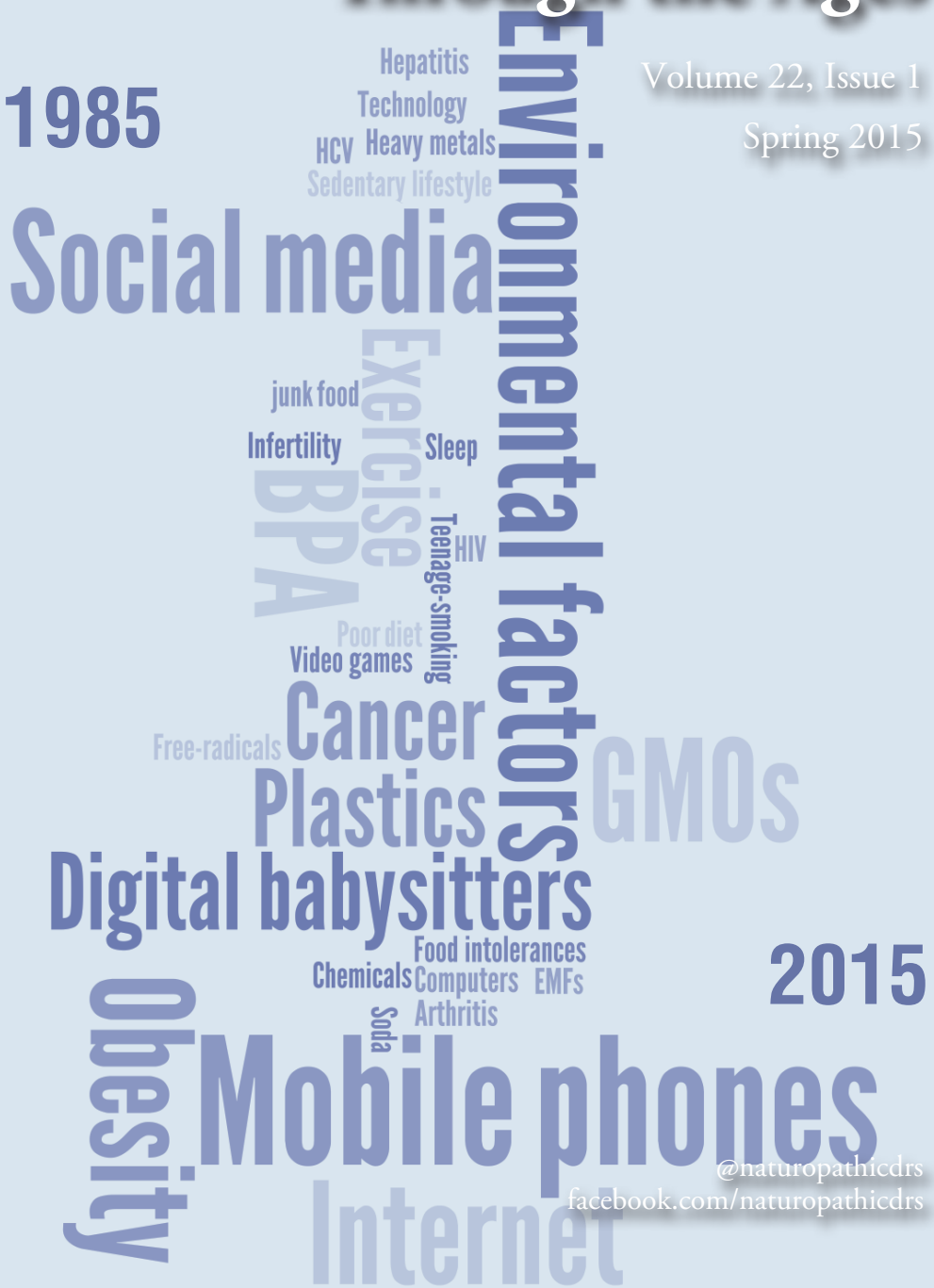

## Feature Articles



# Health Changes Through the Ages


Volume 22, Issue 1

Spring 2015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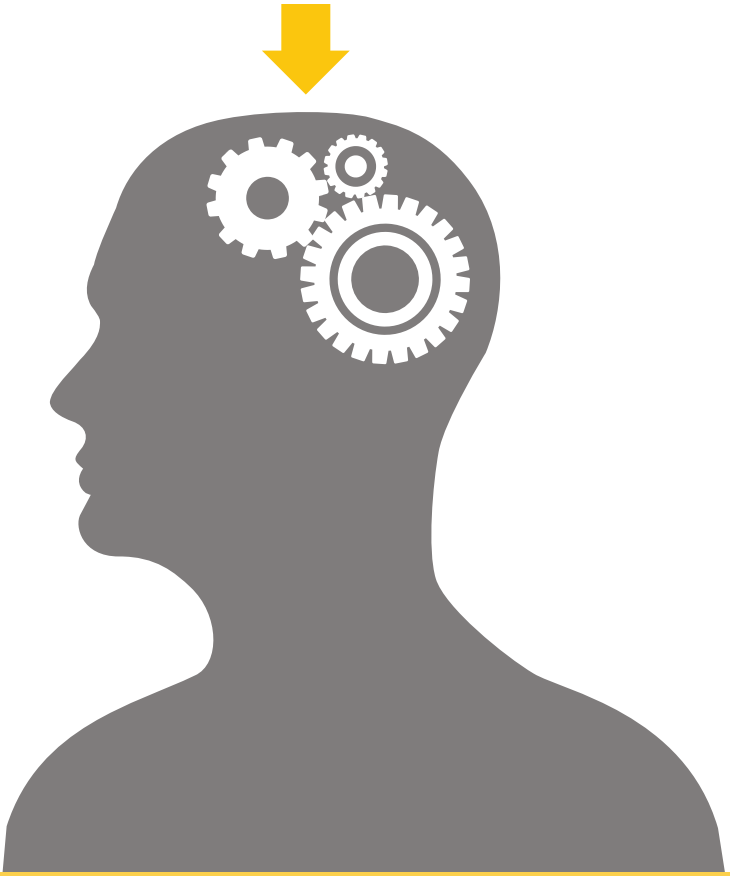


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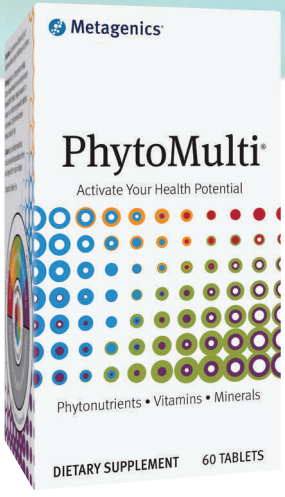


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Vital Link
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**Volume 22, Issue 1, Spring 2015**
Health Changes Through the Ages



**Managing Editor and Advertising**
Alex McKenna • amckenna@cand.ca

**Publisher**
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cand.ca • @naturopathicdrs • facebook.com/naturopathicdrs

**Layout and Print**
J. Sutton Communications • jsuttoncom.com

**Mailing Address**
*Vital Link* c/o Alex McKenna
CAND 20 Holly St., Ste. 200 • Toronto, Canada M4S 3B1
Phone 416.496.8633 • Fax 416.496.8634 • cand.ca

The *Vital Link* is the professional journal of the Canadian Association of Naturopathic Doctors (CAND). It is published primarily for CAND members and features detailed reviews of specific causal factors: philosophical and research-based papers, clinical practice articles and case reviews, as well as international updates on the profession. The *Vital Link* has an outreach to other health care professions and promotes qualified naturopathic doctors to corporations, insurance companies and the Canadian government.

## Forthcoming Themes

**Summer 2015** Digital and Social Media Use
**Fall 2015** Where You Live Affects Your Health

**Submissions**
When writing for the *Vital Link*, keep in mind its broad readership and outreach to other professions. Your contribution to the *Vital Link* will benefit the naturopathic profession as a whole and provide you with personal professional exposure. Previously unpublished material is preferred. Please contact the managing editor for submission guidelines.

**Circulation**
The *Vital Link* is published three times per year and is distributed to over 2400 qualified Canadian NDs and students of CNME-accredited naturopathic programs in Canada and the U.S. The *Vital Link* is also distributed to the CAND's corporate members and in our media kit. The journal is available in print and e-formats, by paid subscription.

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# Naturopathic Notes

**Dr. Iva Lloyd,** BScH, BCPP, ND

For this edition of the *Vital Link* we have chosen to step back and look at how health and disease have changed over the past 30 years. The data reveal there has been a tremendous increase in chronic and life-threatening diseases at all ages. These changes seem largely linked to shifts in lifestyle, as well as the quality and type of food consumed, and an increased exposure to environmental toxins.

Naturopathic doctors Pamela Frank, Amber Moore, Stefanie Trowell and Morgan Winton explore the changing realm of conception and fertility. In their article, the authors highlight the reasons why all aspects of procreation, from conception through delivery have been in a state of unfavourable decline in North America during the past 30 years.

Naturopathic doctors Jennifer MacDonald and Maral Yazandoost explore the changing field of pediatrics, which has seen more than a 51% decrease in infant mortality, yet an increase in several childhood chronic conditions, such as overweight and obesity, micronutrient deficiencies, attention deficit disorder and attention deficit hyperactivity disorder, autism spectrum disorder, asthma and childhood cancers. The authors discuss the overlapping etiologies that have resulted in this disturbing shift.

The adolescent and teen demographics have also experienced a tremendous amount of change. Naturopathic doctors Tannaz Mokhtari, Gayle Heath and Sarah Penney explain how osteopenia, which was once associated strictly with adults, is now becoming a concern in the adolescent population. Another consideration is EMF exposure, including the use of cell phones and other electromagnetic devices, and its impact on behaviour, sleep, obesity and its link to increased cancer risk.

Over the past thirty years in the adult population, we have seen a rise in obesity, diabetes mellitus type 2, cardiovascular disease, hormone-based cancers and sleep disturbances. Naturopathic doctors Laura Brown, Poonam Patel and Camille Sahula explore some of the contributing lifestyle and environmental factors.

Naturopathic doctors Melissa Lee and Andrea Hornyak examine some changes in the baby boomer population, specifically, why the rates of arthritis, HIV and Hepatitis C have increased. The authors discuss the dramatic increase in EMF exposure and environmental toxins and the changes in food and dietary regimen.

There are many theories behind the aging and disease processes, some of which are outlined in Table 1 (see next page). The toxic load of the body is increasing at a tremendous rate and the factors required to properly address these exposures, such as adequate minerals, anti-oxidants, hydration and rest, are decreasing. It is anticipated that the rates of disease, especially chronic disease, and overall mortality will increase, due to a common lack of awareness and attention to the factors contributing to disease.

The objective of this edition of the *Vital Link* is not just to highlight the changes to the health-landscape during the past 30 years, but also to increase the awareness of the numerous factors that are affecting our health and the potential for further, drastic changes. Table 2 provides a historical timeline of some of the key causal factors that have been outlined in this edition's articles.

In the Summer issue of the *Vital Link* we will be exploring digital and social media's positive and negative impacts on health, behaviour and relationships.

*Please see Tables 1 and 2 on following page.*

## TABLE 1: SUMMARY OF AGING AND DYING THEORIES

| MAIN THEORY | SUB-CATEGORY | SUMMARY |
|---|---|---|
| **Biological Aging — Programmed Cell-Death** | *DNA/RNA Damage Theory* | Innate programmed mechanism that sets the duration of life and ensures that there is sufficient turnover to allow for the young. Radiation and other environmental toxins add to the risk of DNA damage. |
| | *Telomerase Theory* | Aging appears to be correlated with decreased length of telomeres which are stretches of DNA at the ends of chromosones. |
| **Biological Aging — Physiological Theories** | *Free-radical Theory* | Aging and death occur as a result of cells becoming permanently damaged from life-long attacks of free radicals. Eighty to ninety percent of all degenerative diseases involve free radical activity and oxidative stress. Environmental toxins, smoking, and consuming processed food, alcohol and other acidic foods and substances all produce free radicals. |
| | *Endocrine Theories* | Biological clocks act through hormones to control the page of aging. All endocrine systems are inter-related. Aging is associated with a decrease in overall hormones |
| | *Immune Theories* | A breakdown in the immune system is associated with age-related changes to the body. The immune system is programmed to decline over time, which leads to an increased vulnerability to infectious diseases and death. Aging is caused by a decline in the immune system's ability to discriminate between self and non-self. |
| **Biological Aging — Non-programmed** | *Wear & Tear Theory* | The wear and tear of life, in particular abuse or overuse, wears out the body, eventually leading to disease states and aging. Aging is the result of progressive cell damage and loss of function caused by both the internal and external environment. The greater an organism's basal metabolic rate, the shorter the life span. |
| | *Waste Accumulation Theory* | Aging is caused by the accumulation of harmful substances and waste products either as a consequence of normal metabolic processes or due to increased exposure to toxins. These waste products interfere with normal cellular functioning and gradually destroy cells. |
| | *Faulty Reconstruction Theory* | The body is in a constant state of repair and regeneration. Aging is a result in the body's breakdown in repair and regeneration processes. |
| | *Mitochondrial Damage Theory* | Increases in glycination increases aging. Glycination is the result of inappropriate attachments or cross-linkages to other molecules. Glycination results in microvascular changes in the arteries, loss of flexibility of connective tissue and decreased mobility or elasticity of proteins and other molecules. |
| | *Rate of Living Theory* | The maximum life span is inversely proportional to basal metabolic rate. There is roughly an equal number of heartbeats within each person's life. In short, this theory states 'live fast; die young'. |
| **Social Aging Theories** | *Disengagement Theory* | Impending death stimulates a mutual psychological withdrawal between the older person and their society. The readiness for disengagement between an individual and society are not always in sync. When the individual is ready and society is not, engagement usually continues. |
| | *Activity Theory* | Healthy aging is associated with continued psychological and social participation throughout a person's life. |
| | *Scaffolding Theory of Cognitive Aging* | Functional changes with aging are part of a lifespan process of compensatory cognitive scaffolding that is an attempt to alleviate the cognitive declines associated with aging. |
| | *Socio-emotional Selectivity Theory* | Reduction in an older person's social networks and social participation should be seen as a motivated redistribution of resources by the elderly person. |

## TABLE 2: HISTORICAL TIMELINE OF KEY CAUSAL FACTORS — COMMUNICATION

| | |
|---|---|
| 1964 | Computer mouse and Windows system invented[1] |
| 1971 | First microcomputers (PCs) were developed (mainframes and minicomputers in wide use in business) |
| 1973 | Cellphone technology introduced[2] |
| 1979 | Fifteen-million PCs in use worldwide. Release of arcade video game, "Space Invaders" starts video-game craze. |
| 1982 | The term "Internet" used for the first time |
| 1988 | Laptop developed |
| 1989 | "World Wide Web" invented |
| 1990s | Multimedia PCs developed with animation and sound |
| 1994 | First wireless technology, Bluetooth, becomes available |
| 1995 | Texting introduced[3] (would not become popular in North America until 2006[4]) |
| 1996 | Internet approaches 10,000,000 host connections |
| 2002 | Wireless computing widespread and Global Positioning System (GPS) becoming popular |
| 2004 | Facebook launched[5] |
| 2006 | Twitter launched |
| 2012 | Twitter reaches 100 million users[6] |

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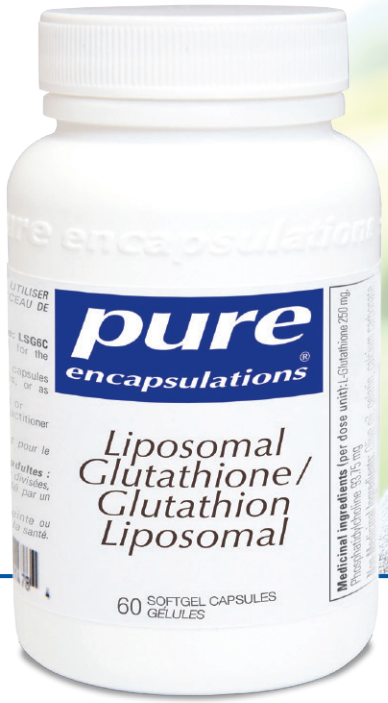


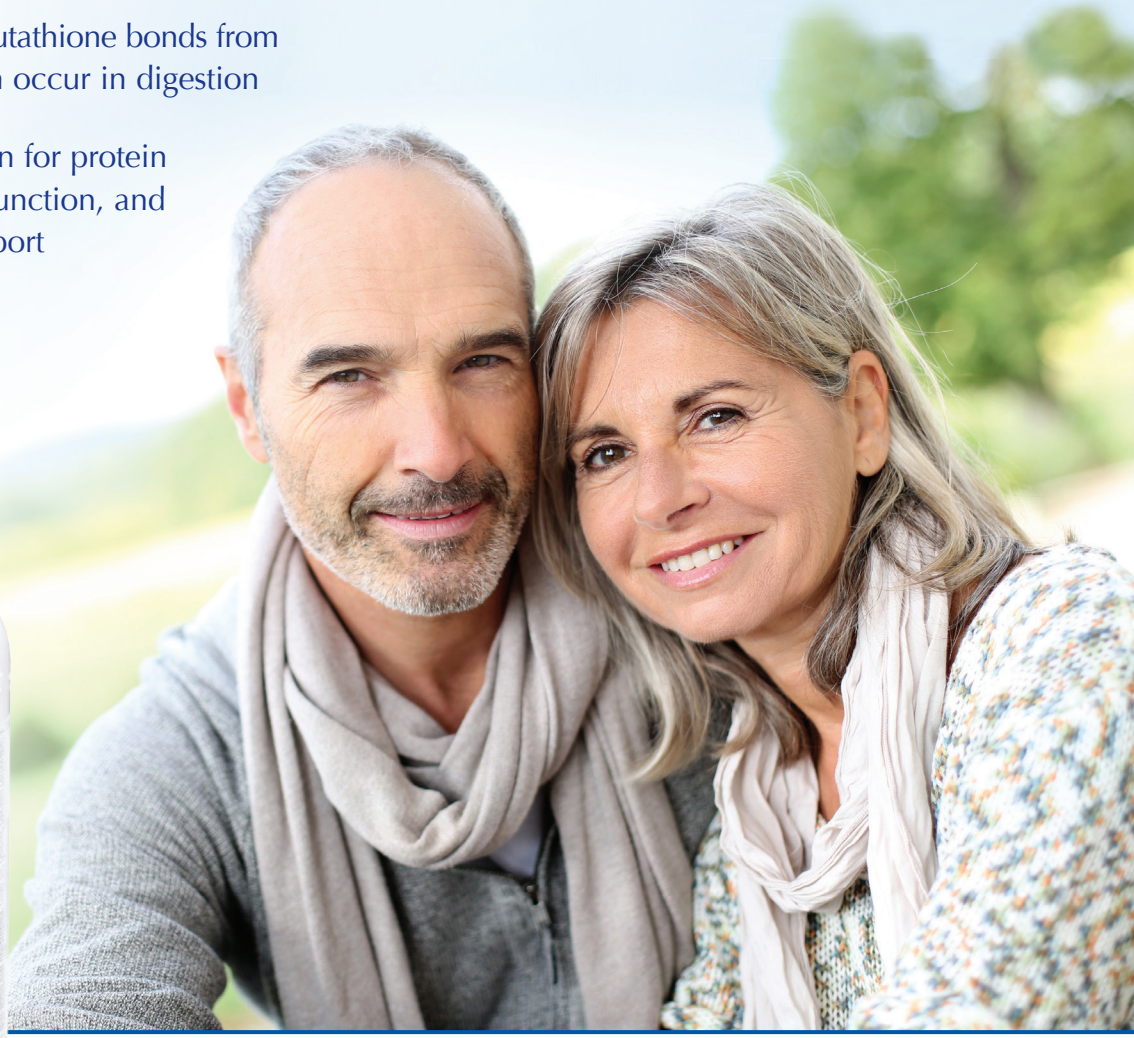

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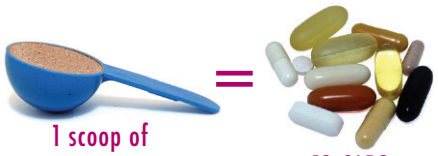

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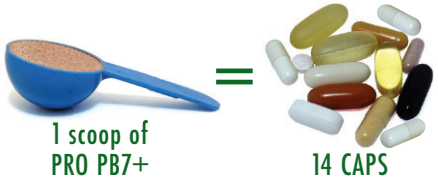

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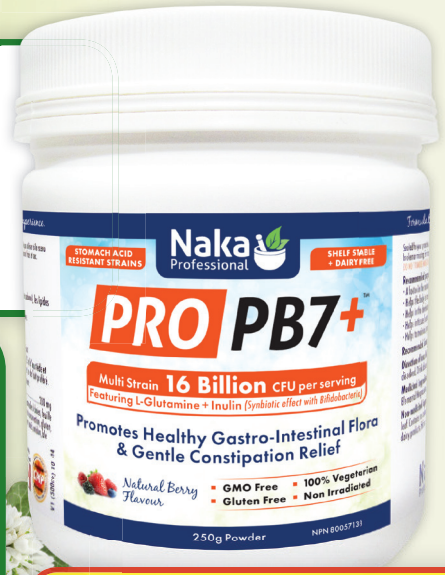


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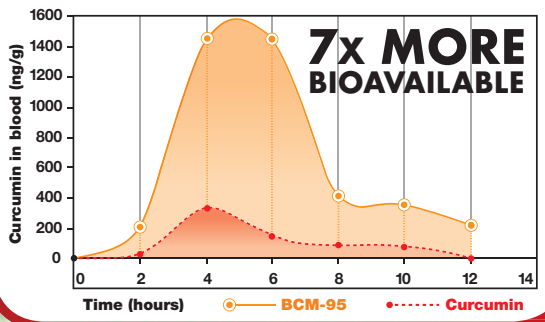



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# Fertility and Conception: Changes During the Past 30 Years Support the Need for Naturopathic Care

**Dr. Pamela Frank,** ND, **Dr. Amber Moore,** ND, **Dr. Stefanie Trowell,** ND **and Dr. Morgan Winton,** ND

Research on U.S. and Canadian populations indicates that all aspects of procreation, from conception through delivery, have been in a state of unfavourable decline over the last 30 years. Declining sperm counts, increasing ovulatory dysfunction, miscarriage and rising rates of caesarean section rates prevail. As naturopathic doctors, understanding the pathophysiology behind the deterioration in human reproduction will enhance our ability to counter societal, environmental and lifestyle factors that are contributing to our waning ability to reproduce.

## Fertility Rates

The definition of infertility may involve some intentional form of family planning or only require unsuccessful conception after a set period of time. Typically in Canada, and for the purposes of this article, the term "infertility" refers to a lack of conception after a period of sexual intercourse without contraception (12 months for women who are under 35 years, 6 months for women over 35 years). Regardless of the definition used, the prevalence of infertility is undoubtably increasing. In fact, infertility affects approximately 16% of Canadian couples.[19,20] This is nearly double the prevalence of infertility 20 years ago (8.5% in 1992) and triple that of 30 years ago (5.4% in 1984).[20] It is estimated that infertility affects over 1.25 million couples in Canada,[21] a very unfavourable trend in both the male and female population.

## Male Factor Infertility

In spite of the focus on female factor infertility, male factor infertility accounts for almost half of infertility cases.[1] During the past 50 years, sperm levels have declined from 113 million/mL in 1940 to 66 million/mL in 1990.[2] There are several theories to this multifactorial problem, most significantly the role of estrogens in the environment, the effect of oxidative stress on spermatogenesis, and the increase in sexually transmitted disease.[3]

Researchers from Washington State University have recently reported seeing effects on sperm from environmental estrogens, such as estradiol and biphenol A (BPA) exposure. Significant quantities of estradiol are found in the urine of women on oral contraceptives, which then passes through waste systems untreated and into our tap water.[5] Certain herbicides and pesticides contribute to xenoestrogen exposure. BPA has also been shown to disrupt thyroid hormones, suppress aromatase activity, and act as an androgen antagonist.[4] Men with detectable urine BPA had more than four times the risk of lower sperm count and more than twice the risk of lower sperm motility.[6] Once an egg was fertilized by the sperm in question, development to blastocyst and pregnancy rates seemed to be the same regardless of whether the sperm was from men with or without high urinary BPA.[7] This is contrary to the fact that we have seen that high urinary BPA can result in higher than average DNA fragmentation in sperm.[7] With the use of assisted reproductive techniques, including in-vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI), the effect of BPA on sperm can be overcome.[7] Of course this doesn't help those trying naturally to conceive. Phthlates are another very common chemical that people are exposed to on a daily basis which can decrease all sperm parameters.[8]

Low intake of dietary folic acid and zinc were correlated with lower motility, low vitamin E with poor morphology, and lower overall antioxidant intake was associated with poor sperm concentration and motility. Overall sperm concentration in the lower dietary antioxidant intake group was 28.6 million/mL vs 50.77 million/mL in the higher intake group, percent motility was 29.5 vs 59.4 and percent normal morphology was 38.4 vs 50.9.[10] Positive associations were also observed between dietary vitamin C intake and overall sperm count and concentration, between dietary vitamin E and motility, and between dietary beta-carotene and sperm concentration and motility.[10] There is a positive association between dietary intakes of vitamin C, lycopene, and beta-carotene on motility. Furthermore, overall semen volume increased with higher dietary intakes of vitamin C.[10,11]

The consumption of high fat foods, such as full fat dairy and meats may hurt sperm results due to the increased presence of lipophilic xenoestrogens which can concentrate in higher fat foods, whereas increasing fruits and vegetables was shown to help semen parameters. All parameters except total semen volume were better in the lower fat/higher fruit and vegetable group, most notably the percent of normal sperm morphology for the high fat group was about 3.7% compared with 22.3% in the lower fat/higher fruit and vegetable diet group.[12] Trans-fat consumption is inversely linked to overall lower semen parameters, including ejaculate volume. The lowest trans-fat consumers had on average 100 million sperm/mL whereas the highest trans-fat group had 3 million sperm/mL.[13]

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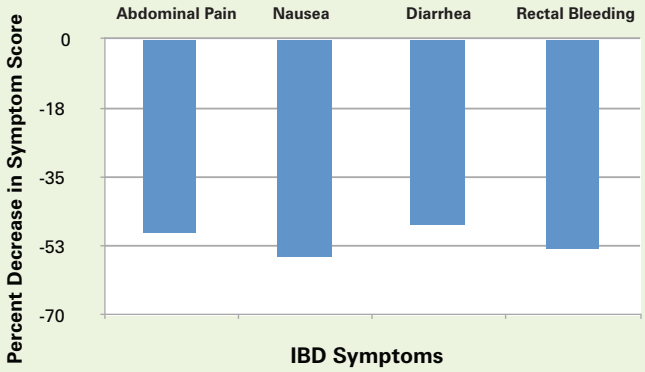


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Studies show that anti-oxidant supplementation can improve pregnancy rates and live birth rates in couples at fertility clinics.[14] More specifically, taking vitamin E 400 mg every day and selenium 225 mcg every day for 3 months improved sperm motility.[15] A meta-analysis of CoEnzyme Q-10 (ubiquinol) supplementation showed an overall increase in sperm seminal concentration and motility.[16] Furthermore in 2012, a study showed that using 200 mg every day of ubiquinol for 26 weeks increased sperm concentration by 81.6%, motility by 31.7% and morphology by 24%.[17] Taking 200 mcg of selenium plus 600 mg N-acetyl-cysteine every day showed a statistically significant increase in concentration, motility, and morphology of sperm.[18]

## Female Factor Infertility

The female contributes significantly to the fecundity of the couple, and when comparing the prevalence of infertility in female partners over the past 3 decades, the numbers are on the rise. In 1984, a woman had about a 5% chance of experiencing infertility regardless of reproductive age; however in 2010, women aged 18 to 29 years had a 7.0-13.7% risk of infertility while women aged 40 to 44 years had a 14.3-20.7% risk.[19,20] The impact of this number grows substantially when we consider that female factors account for nearly 50% of infertility cases.[21] Female infertility can be grouped into 3 categories: ovulatory dysfunction, tubal pathology and pelvic concerns. Of these, ovulation dysfunction contributes considerably to female infertility and has been markedly affected by lifestyle changes by Canadian women.

Ovulation disorders account for 40% of female factor infertility.[22] The possible causes of dysfunctional ovulation include: aging, diminished ovarian reserve, endocrine disorders, polycystic ovary syndrome (PCOS) and lifestyle modifiers (e.g., tobacco use, alcohol intake, unhealthy weight and diet). Of these causes, there have been numerous trends over the years that are unfavourable for female fertility.

The past few decades have seen an increase in maternal age when attempting first pregnancy. Female age as a risk factor for infertility is well understood, with female fertility declining precipitously after the age of 35.[23, 24] Delayed childbearing may be due to a rise in the number of women earning higher education or joining the paid workforce; however, irrespective of cause, both males and females are waiting longer before marriage or cohabitation. The result is an increased proportion of first-born children among women aged 35 and over, from 3% in 1984 to 11% in 2011[20,21] and over 380,000 couples seeking medical assistance for conception.[20] The answer to this age problem is far from clear cut. Women should attempt conception earlier in their reproductive years; however, until financial security and career growth favour young mothers, this trend is unlikely to change in the foreseeable future without more education for women regarding factors that affect their fertility.

In addition to the impact of advanced female age, modifiable factors such as obesity have been shown to adversely affect female fertility. This is particularly relevant for Canadian women, as 45% are considered overweight, with nearly 20% of those women being obese - more than 5 times that in 1981.[24,25] Excess weight affects reproductive functioning women from the hypothalamus to the ovarian follicle. Additionally, obese women are 3 times more likely to suffer infertility than women with a normal body mass index (BMI).[26]

However, it is not all bad news for Canadian women. The percentage of women achieving moderate physical activity levels has increased over the past ten years, from 43 to 52%.[27] During this time, average daily energy intake has reduced slightly (the calories equate to that in a large banana), which should equate to a relative negative caloric balance, but this follows a decade of indulgence and women continue to eat more calories than they expend. From 1991 to 2002, daily energy intake increased 18%, with fat consumption increasing the most.[28,29] Similarly, carbohydrate intake increased 18%, primarily in the form of pasta, specialty breads and cereal-based snacks.[29] This is a concerning trend since ovulatory infertility risk is increased with elevated consumption of processed carbohydrates and there has been a direct correlation observed between ovulatory infertility and consumption of high glycemic index foods.[30] Considering these dietary trends, a moderate level of activity appears inadequate for Canadian women to maintain a healthy BMI. In fact, obesity is the most modifiable risk factor for fertility and has been found to have the greatest impact among women younger than 35 years of age.[30]

Ovulatory dysfunction is associated with other modifiable lifestyle choices, including smoking and alcohol use. The prevalence of smoking has been declining since the 1980s, from over 35 to 18% of Canadian women smoking cigarettes, with the proportion of heavy or moderate female smokers decreasing by more than 10% in the past decade alone.[20, 31] This is significant as women who smoke are 1.6 times more likely to have fertility issues than non-smokers and are less likely to have successful IVF treatments.[20] Unfortunately, over the same time period, the prevalence of heavy drinking more than doubled amongst women aged 20–34 years, from 9 to 20% [20,32]. These factors, as well as excess body weight, promote free radical production and are thought to contribute to poor oocyte quality, DNA damage and female infertility.[33]

Female factor fertility also involves the health of the fallopian tubes and other pelvic structures. Tubal factor infertility accounts for approximately 30% of female infertility cases[20] and of this, it is estimated that 64% is attributable to untreated *Chlamydia trachomatis* infections,[21] a concerning finding since the chlamydial infection rate in Canada has increased 71% for women 20–24 years of age in the past 10 years.[20] The remaining 30% of causative factors for female infertility include endometriosis, uterine complications and cervical abnormalities.[20] These factors are affected, but associated to a lesser extent, by current trends in Canadian society and infertility risk factors previously discussed.

## Miscarriage Rates

While there is some disparity when assessing miscarriage statistics over the years, research suggests that rates of miscarriage are on the rise in North America, increasing by approximately 1% per year.[34] Current estimations note that 15-20% of known pregnancies result

in miscarriage,[35] and women with a history of miscarriage are at higher risk of repeat miscarriages.[36] Some researchers speculate that increased use of home pregnancy tests and artificial reproductive technologies (ART) may have artificially elevated miscarriage rates by bringing increased awareness to early pregnancies and miscarriages that would have previously gone undetected[35] yet the likely influence of other factors must not be discounted.

The most common cause of miscarriage is chromosomal abnormalities, in part correlated to advanced maternal and paternal age.[37] The risk of miscarriage begins to rise in women after age 30, with increasing risk with advancing age;[39] paternal age appears to exhibit a similar trend.[38] A trend towards women having children later in life[39] suggests that this may have a role in rising miscarriage rates.

Modifiable lifestyle factors also contribute to pregnancy maintenance. Obesity research findings parallel that of infertility, with one meta-analysis showing a 67% increased chance of miscarriage with a BMI >25,[40] whereas other research shows that being underweight also increases miscarriage risk.[41,42] Observational research also suggests an increased risk of miscarriage with caffeine intake >200mg/day (equivalent to 1-2 cups of coffee or black tea),[43] alcohol intake[42] and cigarette smoke, both in active smokers and via second hand exposure.[44,45] As described previously, there have been some significant changes in these factors that contribute to oxidative stress. Oxidant-induced endothelial damage is thought to play a role in spontaneous abortion by impairing placental vascularization and inducing phospholipid modifications.[46] These changes are linked to anti-phospholipid syndrome, a hyper-coagulability condition associated with recurrent miscarriage. Additionally, preliminary research has demonstrated an association between low vitamin B6 and early pregnancy loss.[47] Weight loss,[48] aerobic exercise[49] and fish oil[50] have been shown to decrease risk of miscarriage in those with identified thrombotic risk factors.

Stress and its effect on the immune system plays a major role in maintaining a pregnancy. Women with recurrent miscarriage appear to have higher Th1/Th2 ratios[51] and an enhanced pro-inflammatory immune system response as evidenced by increases in TNF-alpha, IL-17[52] as well as decreased immune regulation via Treg cells.[53-55] A large U.S. population-based survey tracked individual's perceived stress between 1983 and 2009, finding we are up to 30% more stressed than society was 30 years ago. Women and those under age 35 were found to be at higher risk.[56] Positive associations between high stress and miscarriage have been shown in many studies.[57] Preliminary research suggests that corticotropin releasing hormone (CRH) and other stress hormones can cause uterine mast cell activation and resultant miscarriage.[58] The role of adrenaline, noradrenaline and acetylcholine on uterine vascularization and contractility,[59] increased TNF-alpha and inflammation,[60] as well as the interplay between cortisol demands and progesterone values[61] also have been proposed. Addressing mental health in patients going through a miscarriage is prudent. A large body of evidence suggests that miscarriage is associated with increased stress, anxiety and/or depression[62,63] and that this risk may be lessened by counselling as well as exploration for cause of miscarriage.[64,65]

Environmental endocrine disruptors and toxins have become increasingly prevalent in our modernizing society and could in part explain trends towards increased miscarriage rates. BPA is a known xenoestrogen and exposure has been correlated with an increased relative risk of miscarriage.[66] Observational studies also demonstrate some evidence that exposure to pesticides,[67] anaesthetic gases,[68] radiation,[69] certain industrial solvents and electromagnetic fields may confer increased risk,[70] albeit research is preliminary in this field.

Thyroid Function: T3 and T4 have direct stimulatory effects on trophoblast function[71] and estrogen and progesterone release from placental tissue.[72] Low thyroid function has been shown to increase miscarriage rates in a number of studies,[73] even with modestly increased TSH values >1.5mIU/ml.[74]

Conventional treatments to prevent miscarriage include aspirin or heparin for proposed or diagnosed thrombophilia, human chorionic gonadotrophin (hCG), progesterone, immunotherapies including intravenous immunoglobulin and bed rest. Of these, only aspirin or heparin for diagnosed antiphospholipid syndrome[76] and progesterone for recurrent miscarriage[75] have good supported efficacy according to Cochrane reviews.

## Natural Birth Rates

Despite the increased risks of maternal mortality and infant morbidity and mortality,[77] rates of caesarean delivery (CD) have steadily increased over the past 20 years and vary widely; on average anywhere from 16-60%[78] in developed nations. Such a wide variation in C-section rates would imply a lack of consensus as to which conditions warrant CD and that some of these surgical interventions may be unnecessary.

The rate of caesarean deliveries in Canada jumped from 17.5% of deliveries in 1994–1995 to 23.7% in 2002–2003[79,80] and again grew to 28% in 2010-2011.[82] The World Health Organization's recommended rate of caesarean delivery, published in 1985, is 10-15%.[83] The three primary reasons cited for CD were dystocia (abnormal or difficult labour and delivery), elective (including previous C-section) and breech presentation.[84] According to the National Consensus Conference on Aspects of Caesarean Birth, dystocia is the indication for approximately one-half of all primary caesarean sections.

Labour dystocia is an ill-defined term that is subject to interpretation. As the primary cause of caesarean section, dystocia warrants critical examination. Zhang et al. in 2010 demonstrated that labor progresses substantially slower than what was historically taught.[85] Their data indicated that labour may take over 6 hours to progress from 4 to 5 cm dilation and over 3 hours to progress from 5 to 6 cm dilation.[85] Despite this revised information, decisions about labour progression and management are still being based on Friedman's curve, a plot of cervical dilation that dates back to 1955.[86] Influences on labour progression include: unripe cervix, contracted pelvis, cervical scarring, macrosomia, fetal malposition, hypotonic or uncoordinated contractions, analgesia/anesthesia, fear and anxiety.[87]

Other contributing factors to caesarean delivery include: maternal obesity,[88] induction of labour (15% CD in induction vs 8% CD in spontaneous delivery),[94] thyroid autoimmunity (abnormal TSH/positive anti-Tg)[89] women over 45 who conceived via ART,[90] anterior placental location, advanced maternal age,[91] adenomyosis,[92] acute maternal bleeding[93] and fetal indications such as fetal weight, multiple gestation, intra-uterine growth restriction, abnormal or indeterminate fetal heart rate, oligohydramnios, placental abruption, macrosomia and post-term pregnancy.[94,95]

| ADVANTAGES OF VAGINAL DELIVERY | DISADVANTAGES OF CAESAREAN SECTION |
|---|---|
| 1. Quicker recovery time and no scars (2 days or less hospitalization vs 4 for c-section) | 1. Greater risk of pre-term delivery and concomitant complications for the infant |
| 2. Lower mortality risk for the mom and infant[99, 102] | 2. Increased risk of complications of anesthesia, puerperal infection, and venous thromboembolism[99] |
| 3. Lower risk of iatrogenic complications[102] | 3. Higher maternal mortality (3.6 times higher after caesarean than after vaginal delivery)[99] and infant mortality (69% increase[102]) |
| 4. Birth occurs on the baby's schedule, when he or she is physically ready | 4. Greater risk of post-partum depression (more than six times the risk of developing postnatal depression three months postpartum[103]) |
| 5. Vaginal birth allows the child to acquire normal flora at delivery | 5. Greater likelihood of subsequent caesarean deliveries. In subsequent pregnancies, although there is a small risk of uterine rupture, blood transfusion and hysterectomy, women who attempt vaginal birth after caesarean have a much lower rate of mortality than women who have a subsequent elective caesarean. |
| 6. Better maternal-infant bonding and lower risk of post-partum depression[100] | 6. Greater incidence of allergies and asthma in children delivered by c-section[101] |

## Conclusion

The unfavourable trends for fertility, miscarriage and delivery witnessed over the past 30 years suggest the growing need for practitioners to prudently assess and treat hopeful parents with a slightly different emphasis than perhaps was done previously. Many of the factors negatively affecting procreation are lifestyle and environmental in nature; our modern world is affecting our waist sizes, stress levels, diet composition, toxin exposure and age of first conception, to name a few factors. Foundational naturopathic care for fertility involves appropriate investigation and intervention to address such risk factors, and highlights our integral role as health educators to maximize chances of successful reproduction.

## Recommendations:

There are many specific treatments that reach beyond the scope of this article that would be indicated in treating infertility, reducing risk of miscarriage and encouraging a healthy labour. However, following are some key areas to assess for reproductive success.

| NATUROPATHIC RECOMMENDATIONS TO ADDRESS CHANGING CANADIAN HEALTH TRENDS | PRECONCEPTION & FERTILITY Male | PRECONCEPTION & FERTILITY Female | PREGNANCY | LABOUR & DELIVERY |
|---|---|---|---|---|
| Educate patients regarding importance of family planning at a younger age | age-related infertility | age-related infertility | miscarriage risk | |
| Counsel patients on proper nutrition, diet and exercise to achieve healthy BMI | sperm motility & morphology | oocyte quality & quantity | miscarriage risk | maternal weight affects type of delivery |
| Emphasize importance of practicing safe sex as a young adult and gynecological screening exams (especially STI swabs) | lowering sperm counts | tubal factor infertility | | |
| Reduce exposure to environmental toxins, sources of BPA and xenoestrogens | sperm concentration & motility | endocrine disruption of ovulation | miscarriage risk | |
| Encourage healthy lifestyle choices, notably:<br>- avoiding exposure to cigarette smoke<br>- reducing consumption of alcohol | oxidative damage to sperm | oxidative damage to oocytes | risk of spontaneous miscarriage | |
| Screen for mental health concerns, such as high stress, anxiety or depression. | age-related infertility | oocyte quality & quantity | correlated with miscarriage | |
| Consider naturopathic intervention (e.g. nutraceutical, herbal, acupuncture) to improve hormone balance and fecundity. | emphasis on antioxidants & specific nutrient deficiencies | | | |
| Evaluate thyroid function (TSH and anti-thyroglobulin antibodies) and treat discrepancies. | | ovulatory dysfunction | TSH > 1.5-2 associated with miscarriage | Re-assess at 15-28 weeks gestation |
| Recommend doula care - the odds of non-indicated caesarean were 80-90% lower among doula-supported women.[105] | | | | |
| Educate patients as to normal gestation period (particularly for nulliparous) and labour progression. Encourage women to labour in an upright position.[104] | | | | reduce induction & caesarean deliveries |
| Recommend moxibustion at BL67 between 33-35 weeks gestation in women with breech presentation.[97,98] | | | | |

## About the Authors

**Pamela Frank, BSc (Hons), ND** has 15 years of experience as a naturopathic doctor and 20 years as a medical laboratory technologist. She is Clinic Director of Forces of Nature Wellness in Toronto and was twice voted "Best Naturopath in Toronto". Pamela maintains a busy practice with particular expertise in women's health issues including natural conception and fertility. Other passions include her family, tennis, running, cycling, ballroom dancing, and healthy cooking. For more information www.NaturopathToronto.ca.

**Stefanie Trowell, ND** is a licensed naturopathic doctor practicing in Toronto, Ontario. After graduating from the Canadian College of Naturopathic Medicine, she achieved acceptance into the competitive Clinical Residency program, which has placed Stefanie at the heart of evidence-based medicine and research. In addition to her work at the College, Stefanie enjoys seeing patients in her private practice. She is passionate about optimizing health through prevention and management of chronic disease, with a special interest in fertility and cancer care, especially breast cancer. Prior to moving to Toronto, Stefanie graduated from the University of Saskatchewan with a High Honours Bachelors of Science in Physiology, where she assisted with research in neuroscience, endocrinology and reproduction. Stefanie now focuses her analytical brain and problem-solving skills on the complexity of hormonal health in women. She is a dedicated and caring doctor with a gentle approach who is committed to the health of her patients For more information, visit www.stefanietrowellnd.com.

**Amber Moore, ND** is a graduate of the Canadian College of Naturopathic Medicine (CCNM), and is currently in the process of completing her clinical residency at CCNM. She is the cofounder of Nourish Integrative Health in midtown Toronto, a naturopathic clinic catering to the needs of women with a focus on infertility and breast cancer. Amber strives to be an advocate for her patients by employing a collaborative approach with a patient's health care team, and strongly believes in empowering her patients through health education. She has received additional training in women's health and naturopathic oncology during her clinical residency, and is licensed in intravenous therapy to provide comprehensive naturopathic care. For more information, visit www.nourishtoronto.com.

**Morgan Winton, ND** is a naturopathic doctor who has been practicing in Toronto's downtown core for over 10 years. She maintains a general practice, but has a special interest in fertility. She can be reached through her website at www.morganwinton.com.

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# Changes in Pediatric Health Over the Past 30 Years

**Dr. Maral Yazdandoost,** BSc, ND and **Dr. Jennifer MacDonald,** BSc, ND

Globally, there has been a 51% decrease in the rate of child mortality since 1985.[1] This change has caused a shift in focus from reducing infant and child mortality to addressing the consequences of rapid industrialization of developing countries on a children's health.[2] Modernization is increasingly associated with a rise in several childhood chronic conditions,[3] including: overweight and obesity, micronutrient deficiencies, attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), asthma and certain childhood cancers (see Figure 1). An examination of these disorders and their often over-lapping etiologies will guide practitioners' decisions in optimizing strategies for disease prevention and management.

**TABLE 1: CHILD HEALTH: A SNAPSHOT OF THE PAST 30 YEARS**

- Child and infant mortality has decreased by half in the last 30 years
- Chronic childhood diseases, such as ADHD, autism and asthma are on the rise
- Childhood overweight and obesity rates are epidemic; 1 in 5 Canadian children are overweight or obese
- Micronutrient deficiencies and environmental exposure to pesticides, pollutants and phthalates are potentially linked to the development of childhood disorders such as ADHD, cancer, asthma and autism

## Overweight & Obesity

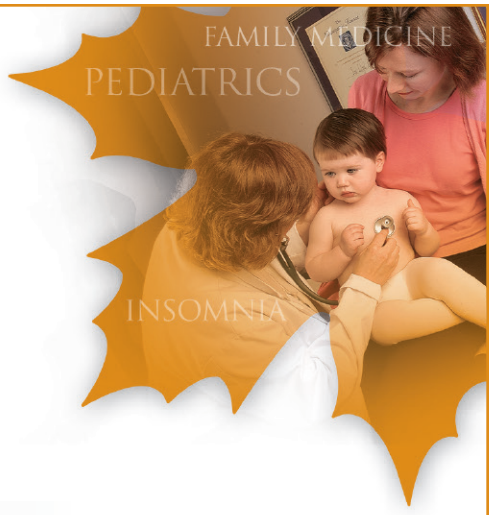
It is widely accepted that the rise in overweight and obesity, particularly among children, has reached epidemic proportions during the past 20-30 years. Between 1980 and 2013, the prevalence of overweight and obese children and adolescents rose by 47.1% worldwide, reaching a prevalence of 25.5% for boys and 22.0% for girls in Canada.[4] This unprecedented epidemic has been attributed to a number of factors outlined in a review by the World Health Organization (WHO): International Obesity Task Force,[5] which include a decrease in physical activity and a rise in sedentary leisure activities for children, increased opportunity and dependence on purchasing calorie-dense, but nutrient poor processed and convenience foods, the rising use of sugary drinks to replace water at school and home and, perhaps most troubling, the aggressive marketing of these calorie-dense foods to toddlers and children.

Overweight and obese children face greater health challenges throughout their lifetime. A recent cross-sectional study of Canadian children revealed that obese and overweight children had greater rates of internalizing disorders, asthma, other respiratory disorders, otitis media, and chronic adenoid/tonsil disorder than children of normal weight.[6] The obese and overweight children also incurred higher healthcare costs than others of normal weight, thereby placing an increased burden on public health. This burden follows overweight and obese children into adulthood; an analysis of data from longitudinal cohort studies in the U.S. and Australia revealed that overweight or obese children were found to be four times as likely to become obese adults.[7] They were also found to have increased cardiovascular risks, as measured by a significant association with hypertension and high-risk triglyceride levels.[7] Further cardiovascular risks, including increased carotid intima-media thickness, left ventricular hypertrophy, as well as functional alterations of the heart and arteries were observed in obese children, along with early markers of renal dysfunction.[8] It is clear that the present and future consequences of increasing childhood overweight and obesity rates pose a serious health-care concern.

## Micronutrient Deficiency

The rapid pace of development during the past 30 years has led to a so-called "nutrition transition" characterized by the increased adoption of the Western diet. This has created a double burden of malnutrition (DBM) particularly for micronutrients such as iodine, iron, vitamin A, vitamin D and zinc.[9] While the prevalence of overweight and obese children in Canada and much of the developed world seems to be primarily a problem rooted in inappropriately high caloric consumption, the prevalence of micronutrient deficiency persists in these same populations, implying malnutrition. This paradoxical phenomenon is sometimes referred to as "hidden hunger".[10] As adequate levels of micronutrients are necessary in preventing chronic disease, hidden hunger is often implicated in determining health status and quality of life.

Among the micronutrients in question, vitamin D in particular has been the object of much research in recent years. Apart from its role

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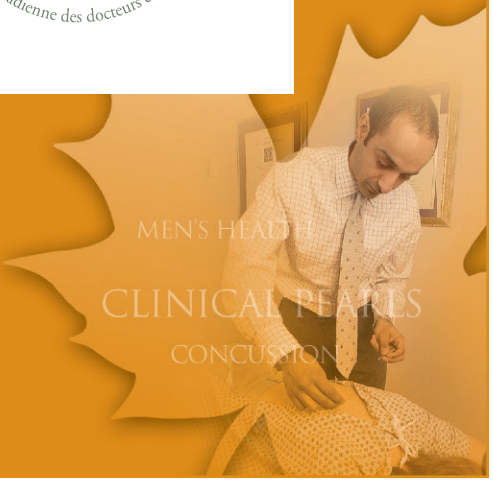

**FIGURE 1: PREVALENCE OF CHILDHOOD DISEASES**
As per NHIS data for children less than 18yo at www.cdc.gov


in bone mineralization, it is increasingly linked to healthy immune function and cell proliferation, and it is believed to play a role in the prevention of several chronic diseases later in life.[11] A review of studies evaluating vitamin D status in U.S. children found widespread insufficiency of this critical micronutrient.[12] Similar results were obtained in a 2012 Canadian study by Omand et al.[13] focusing on differences in vitamin D status between immigrant and Western-born Canadian children. The study showed only 3% of Western-born children had vitamin D levels below the accepted cut-off point of 50 nmol/l, whereas 12% of immigrant children exhibited low levels. The researchers determined that supplementation with vitamin D was the likely cause of this difference. The study highlighted vitamin D supplementation as a therapeutic target in Canada; the case for supplementing vitamin D is further strengthened by the fact that despite the fortification of many common food items with vitamins A and D, vitamin D insufficiency remains problematic in the U.S. and in Europe.[11] As a result, recommended daily intakes of vitamin D have been increased from 200 IUD to between 600-800 IUD.[14]

One childhood condition that is often overlooked as being potentially symptomatic of micronutrient deficiency is pica, or the tendency to ingest nonfood items. A recent meta-analysis found a significant association with increased risk for iron deficiency anemia, as well as low plasma-zinc-levels in individuals who engaged in pica behaviours.[15] Interestingly, in the U.S. hospital stays relating to pica increased by 93% in the decade encompassing 1999-2008, and in 2009, 31% of children hospitalized with pica had a diagnosis of autism spectrum disorder.[16]

## Autism Spectrum Disorder

The incidence of autism spectrum disorder (ASD) worldwide is between 30-60/10,000, which is nearly a seven to 15-fold increase from estimates 40 years ago.[17] Figure 1 shows a steeper rise in ASD prevalence over the past 30 years, in comparison to other childhood diseases such as asthma and cancer. A greater awareness, improved detection, and expanding definitions, have all been postulated as contributing to the rise, but increasingly researchers are exploring the role of nutritional deficiencies, alternate metabolic pathways, environmental factors and immune dysfunction in the etiology of ASD.[18]

Fortification of certain foods and perinatal supplementation with folic acid has increased widely since the late 1990s due to the discovery of its role in protecting against neural tube defects.[19] Despite this, folic acid deficiency can occur in consecutive pregnancies that follow too closely to a previous delivery. Subsequent children conceived and delivered in these shorter intervals have a greater risk of developing ASD.[20] Genetic analysis of particular polymorphic forms of methylenetetrahydrofolate reductase (MTHFR), required to activate folic acid for methylation in neurodevelopment, have highlighted the possibility that increased folic acid supplementation protects the developing fetus from higher plasma homocysteine levels that may otherwise cause a miscarriage. This same polymorphism is found at a significantly higher frequency in children with autism,[18] perhaps indicating a need for continued supplementation of these children, with high levels folic acid, particularly in its bioactive L-methylfolate form.

Environmental factors that have been implicated in the development of ASD include the vaccine preservative, thimerosal,[21] gestational toxicants such as pesticides, solvents, polychlorinated biphenyls (PCBs) and air pollutants and early childhood exposure to toxicants such as pesticides, toxic waste sites, phthalates, air pollutants and heavy metals.[22] Though the research thus far has been controversial and hotly debated for many of these factors, a growing body of evidence is linking genetic polymorphisms to an increased

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susceptibility to environmental exposure in the development of ASD.[22] It is also noteworthy that many of these environmental toxicants are implicated in causing immune dysregulation.[22]

Significantly different patterns of immune function have been observed in children with ASD including neuro-inflammation; higher circulating pro-inflammatory markers in blood and cerebrospinal fluid; increased occurrence of auto-antibodies to brain tissue; and altered immune cell function.[23] These alterations in immune function have also been linked to some of the classical behaviours of ASD relating to social interaction and communication.[23] Extreme food selectivity is another behaviour seen widely in children with ASD, particularly in their avoidance of fruits and vegetables. It has been suggested that this behaviour is due to disturbances in their intestinal microbiome.[24] The role of the intestinal microbiome in helping to develop and regulate the immune system is well documented,[25] suggesting a powerful therapeutic approach for children with ASD through the use of probiotics and the modulation of diet to correct relative insufficiencies.

## ADHD

Attention deficit hyperactivity disorder (ADHD) is one of the most commonly diagnosed mental health disorders among children in North America,[26] yet interpretation of prevalence studies is complicated by significant changes to the diagnostic criteria for ADHD in the past 30 years. Since 1980, the diagnostic criteria for ADHD have been changed and updated with each iteration of the Diagnostic and Statistical Manual of Mental Disorders,[27] creating a more inclusive set of features, which results in an increase in the number of children diagnosed each year. Currently, ADHD is diagnosed in 3% to 11% of school-age children in the U.S. with peak age of diagnosis between 7 to 10 years old.[28] ADHD affects approximately 2.6% of Canadian children and the mean age of diagnosis is between 3 to 9 years old.[29] In Canada, the prevalence of prescribed ADHD medications has increased from 1.3% to 2.1% between 1994 and 2007.[29]

There have been reported disparities, however, between the prevalence rates in the U.S. compared to other places, such as Europe.[28] Some studies suggest that the prevalence rates in Europe are lower than in North America.[30,31] These differences might be due to the different ADHD-diagnostic-criteria that are used. The European criteria are stricter than the diagnostic criteria used in North America (Table 2). After controlling for the different diagnostics used to define ADHD, no significant differences between countries were found.[28,32] The spectre of over-diagnosis, with its concomitant pharmacotherapy, may be an appropriate topic for education between naturopathic doctors and their patients.

The etiology of ADHD is complex and involves a mix of genetic, social and environmental risk factors.[27] Twin studies examining the extent to which identical twins are more concordant for ADHD than fraternal twins demonstrates a genetic component to the development of ADHD. As with ASD, genetic polymorphisms may

**TABLE 2:** Differences between U.S. and European criteria of attention-deficit hyperactivity disorder or hyperkinetic disorder (HKD)[71]

| | **DSM-IV ADHD (American)** Either or both of following: | **ICD-10 HKD (European)** All of following: |
|---|---|---|
| **Symptoms** | At least six of nine inattentive symptoms<br><br>At least six of nine hyperactive or impulsive symptoms | At least six of eight inattentive symptoms<br><br>At least three of five hyperactive symptoms<br><br>At least one of four impulsive symptoms |
| **Pervasiveness** | Some impairment from symptoms is present in more than one setting | Criteria are met for more than one setting |

function to increase the susceptibility of the brain to exogenous chemicals affecting neurological functioning.[33] Some of these chemicals include: phthalates, organophosphate pesticides (OP), and PCBs.[29]

Developmental exposure to OPs and PCBs can affect neurotransmitters, causing ADHD-like behaviours such as inattention and greater impulsivity.[34] Both pre and postnatal exposure to OPs were associated with higher rates of children diagnosed with ADHD.[34] PCBs are environmental contaminants that readily cross the placenta and can disrupt dopaminergic function. Decreased dopamine is correlated with ADHD.[34] Studies have shown that prenatal phthalate exposure is associated with childhood development of ADHD.[35,36] Phthalates have also shown a dopamine gene-phthalate interaction.[36] Independent of an ADHD diagnosis, phthalate exposure has been shown to be linked to ADHD like behaviours such as aggression, attention difficulties, and conduct problems.[38]

Additionally, the complex changes underlying brain growth and development during pregnancy and childhood confer vulnerability to neurotoxins such as arsenic, toluene, mercury, and lead.[37] Lead is a potent developmental neurotoxin that can cause numerous neurological effects, including affecting the dopaminergic neurons of the brain involved in behavioural control.[39] Mercury exposure causes developmental neurotoxicity[40] and prenatal mercury exposure is associated with increased risk of developing ADHD.[41] Given these associations, knowledge of the neuro-behaviour alterations of chemical exposure should be used by practitioners with regards to both prevention and management of ADHD.

## Asthma

Asthma is a common chronic condition among children, and its prevalence worldwide has steadily increased over the past 30 years.[42] According to Statistics Canada, 11% of Canadian children in 1995 were diagnosed with asthma and by the year 2001 the prevalence had increased to 13%.[42] In Ontario, the number of individuals with asthma increased by 70.5% from 1996 to 2005, and asthma has become the leading cause of hospitalizations in children under 15

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**FIGURE 2: INCIDENCES OF CHILDHOOD CANCERS**
As per the SEER Cancer Statistics Review 1975-2011


years of age.[43] The morbidity of asthma has also increased. Between 2001 and 2010, the rate of children's emergency department visits for asthma rose by 13.3%; concurrent with a steady increase in airway hyper-responsiveness of asthma that has occurred over the past three decades.[44] More recent evidence suggests that asthma rates have plateaued within the past three years and rates may even be declining in some areas such as North America and Europe. [43]

In exploring the etiology of asthma, it is apparent that two well-supported risk factors for the development of asthma in children are tobacco smoke (both *in utero* and post-natal) and obesity.[42,45] As with ASD and ADHD, exposure to environmental toxins such as bisphenol A, pesticides and phthalates is associated with an increased prevalence of childhood asthma.[46] Endocrine disruptors such as bisphenol A can affect the production of inflammatory mediators and can lead to hyperactivity of the immune response.[44, 48] Phthalate exposure has been shown to increase the prevalence of pediatric asthma and has increased allergic sensitization.[48] Exposure to outdoor air pollution containing combustion by-products petroleum, polycyclic aromatic hydrocarbons (PAHs) and dioxins[49] is associated with an increased risk of children developing asthma,[45] a worsening of symptoms[48] and an increased risk of hospitalization.[49] These contaminants are found in areas close to highways and freeways, with more severe symptoms and higher prevalence found in populations living within 200 meters from the road.[50] Lower income urban centres with a higher proportion of pests and indoor nitrogen dioxide levels were also found to contribute to higher rates of pediatric asthma.[51]

Further etiological studies have found that food intolerances are implicated in the development of pediatric asthma. Studies have suggested that food allergen sensitization causes airway inflammation and is a risk factor for the development of asthma.[52,53] Food allergy is associated with six times the odds of developing asthma compared to individuals without a food allergy.[53] Egg, cow's milk, peanut, and tree nut allergies are the allergies that are most strongly associated with the development of asthma.[54] Sub-optimal nutrient intake may enhance asthmatic inflammation, consequently contributing to bronchial hyperreactivity.[55]

Consuming a Mediterranean diet during pregnancy, ensuring the maintenance of adequate vitamin D levels and a high intake of anti-inflammatory polyunsaturated fatty acids are some factors associated with reduced risk of developing pediatric asthma.[56, 57]

## Childhood Cancers

Childhood cancers are relatively rare in both industrialized and developing nations, comprising only 4% and 1% of child deaths, respectively.[58] Recent evaluations of incidence of childhood cancer have determined a minimal rise in the US,[59] and mostly stable rates of disease in Europe[60] (see Figure 2). The biggest trend in childhood cancers in the past 30 years is the improvement in survival rates.[61] Nevertheless, childhood cancers, particularly acute lymphocytic leukemia (ALL), lymphoma and tumours of the central nervous system are the second leading cause of death in children aged 1-14 years in developed countries and, therefore, remain the focus of much scrutiny.[62]

While some childhood cancers can be attributed to inherited genetic abnormalities, the etiology of most childhood cancers remains elusive. In children, it is more difficult to identify environmental factors, due in part to the rarity of childhood cancers and because it is difficult to gauge what children may have been exposed to early in their development.[62] Additionally, because many child cancers arise between the ages of 1 and 4 years, it is difficult to attribute causality to agents that typically have a longer latency period.[58] However, there is emerging evidence that early childhood exposure to common and self-limiting infections may play a protective role in the development of ALL.[64]

To date, the only risk factors definitively linked to the occurrence of leukemia, thyroid cancer and other cancers in children are ionizing radiation from atomic bombs,[64] diagnostic imaging[65,66] and nuclear power plant malfunctions, respectively. In 2008, a comprehensive review by Canadian researchers studying other possible environmental risk factors for childhood cancers, including parental exposure to cancer-causing chemicals, intrauterine exposure to pesticides, childhood exposure to common infectious agents, cigarette smoke, asbestos, and ultraviolet radiation from the sun, and living near a nuclear power plant, determined as yet limited associations to the development of childhood cancers.[67]

More recent research suggests the effects of pesticides on childhood cancer incidence may have been underestimated due to the exclusion of toxic adjuvants that display additive effects with glyphosates.[68] Perhaps the most relevant insights come from a recent systematic review examining residential traffic exposure and childhood leukemia, which found a positive and significant association between the two.[69]

## Conclusion

There is a common thread of nutritional deficiency, toxic exposure and immune dysfunction in the childhood diseases we have discussed, in their 30-year context. The implications of these findings are quite pertinent to our increasingly urban population and present an opportunity for naturopathic doctors to advocate for therapies that mitigate damages posed to the developing immune system by the combined burden of pollution, environmental toxins, and poor nutrition.

Many risk factors associated with the increased prevalence of these conditions are preventable. Naturopathic doctors are, therefore, in a unique position to offer comprehensive dietary and lifestyle counselling for pediatric patients and their caregivers. It seems clear that optimization of a vital and adaptive immune system is paramount in helping pediatric patients stay healthy. Recent research has revealed an expanded role of the intestinal microbiome in producing micronutrients, and helping to strengthen and modulate the immune system[70] in addition to breaking down and digesting food. The establishment of a healthy intestinal microbiome may therefore be an appropriate therapeutic goal in treating children with ASD, ADHD or asthma and those fighting the dual burden of malnutrition or suffering the fight against childhood cancer.

## About the Authors

**Maral Yazdandoost, BSc, ND** obtained her Honours Bachelor of Science from McMaster University in 2004; specializing in biology and psychology. She then continued her education at the Canadian College of Naturopathic Medicine, graduating in 2009. Dr. Yazdandoost practiced as an associate naturopath in Richmond Hill, maintaining a general family practice with a focus on pain management and injury recovery. During this time she also held teaching positions at the University of Toronto Scarborough, first as a TA then as a sessional instructor. In late 2013, she left Canada to join her husband abroad for a teaching opportunity; since then she has been actively researching evidence-based naturopathic treatments and reflecting on the art and practice of effective, compassionate care.

**Jennifer MacDonald, BSc, ND** graduated from the Canadian College of Naturopathic Medicine and practices in Toronto and Vaughan (Woodbridge) Ontario. She maintains a general family practice with a special interest in women's health, fertility, and autoimmune conditions. Prior to becoming a naturopathic doctor, Jennifer completed a double major in microbiology & immunology and biology from Dalhousie University. She loves educating others about naturopathic medicine, and brings her passion for education to the courses she teaches at the Canadian School of Natural Nutrition. Jennifer is also an avid public speaker and enjoys educating the community about naturopathic medicine and wellness. For more information visit drjenmacdonald.com and follow @JenMacDonaldND.

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# Considerations in Practice for Treating Adolescent Patients

**Dr. Tannaz Mokhtari,** BSc, ND, **Dr. Sarah Penney,** MSc, ND, **Dr. Gayle Maguire**, BSc, ND

The physical, emotional and social changes that begin in childhood and continue during adolescence can have significant impacts on health and genetic predispositions to disease. It is an important stage of development, with many influences to be aware of in order to protect our adolescents and to help them grow into happy and healthy adults.

Unique considerations for this population may include the impact of lifestyle choices on bone health, the prevalence of cigarette smoking and drug use, and exposure to electromagnetic frequencies. Recommendations for these issues have been summarized from current research.

## Bone Health

Approximately 40% of our bone mass is developed during adolescence, influenced by nutritional factors, exercise habits, genetics and various medical conditions.[1] Bone remodeling and growth is highly active and favours construction over resorption in the first 30 years of life. This is followed by a stable period of bone density and an eventual decline. Positive bone health in childhood and adolescence is inversely correlated to the risk of developing severe bone loss, such as osteoporosis, later in life.[2] Healthy bone development in childhood and adolescence is important in many ways to future physical activity and health; as bones also act as a reservoir for various minerals such as calcium, magnesium and phosphorus, it is very important to enhance the health of bones during this period of growth in an effort to reduce the risk of exaggerated bone loss later in life.

The diagnosis of osteopenia has been identified as a growing problem in this demographic, and this is reflected in recent literature addressing prevention and treatment. Although genetics does play some essential roles in bone accrual during this time, intake of various nutrients and activity are important modifiable factors. Guidelines for optimization of bone health in children and adolescents released in 2014 outlined several important nutrients and nutritional factors that influence growth.[3] Calcium is essential during remodeling; recommendations for those aged 14-18 years is 1300mg of dietary calcium per day accompanied by at least 600 IU of vitamin D. Data collected from the NHANES 2003-2006 surveys indicated that less than 15% of adolescents in the U.S. met these requirements.[4] Vitamin D is essential in the absorption of calcium, and adolescents are at a higher risk of developing deficiency than children, possibly due to lower levels of body fat where vitamin D is stored. Preliminary research has also demonstrated that magnesium is an important nutrient during bone growth, suggesting that accrued bone mass is directly proportional to intake of this mineral.[5] Intake of carbonated beverages has been shown to negatively affect the development of bone mass, possibly due to a corresponding decrease in the consumption of calcium rich beverages. A diet high in sodium or low in protein additionally increases the excretion of calcium and should be addressed.[4] Another largely overlooked source of calcium that is lacking in the diets of adolescents is the fruit and vegetable food group. Intake of this food group appears to be an independent predictor of bone accrual in adolescent boys, which may be an important point during nutritional counselling, especially for children whose diets are dairy-free.[6] Diets containing adequate plant foods may increase alkalinity, which appears to decrease urinary calcium excretion.[7] The overall decrease in mineral intake among adolescents relative to recommended daily requirements, combined with dietary choices that may predispose to acidity, may set-up the body for early bone loss and decreased accrual.

The most dramatic effect of exercise on bone health may also occur during puberty and the adolescent years. It is important to note that in athletic females, exercise significantly increased bone mineral density compared to non-athletic peers, but this benefit did not prevail when menstruation ceased due to low body weight.[8] Weight is an important consideration in the adolescent population. While a healthy body weight is important to stimulate bone growth by providing a mechanical load during daily activities, both high adiposity and low body weight can increase risk for fracture in this population.[9] Obesity can increase inflammatory mediators that encourage bone resorption, while a low body mass index (BMI) may be an indication of poor nutrient intake or it may lead to hormonal imbalances that can affect bone health.

An important group of medical concerns in this population are those that lead to malnutrition, including anorexia nervosa, bulimia, and the 'female athlete triad' (amenorrhea and decreased bone mineral density accompanying an eating disorder). The onset of these conditions is often during the adolescent period of peak bone growth, and may manifest in osteopenia during adolescence or osteoporosis later in life due to insufficient nutrient intake, low body weight and hormonal imbalance.[9] Early identification and awareness of these conditions are paramount in decreasing future risk of osteoporosis.

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## Cigarette smoking and drug use

In recent years, tobacco cigarette smoking, alcohol and drug use (illicit and prescription) have been trending downward, according to the University of Waterloo's *Canadian Student Tobacco, Alcohol & Drugs Survey*.[10] The decline was most dramatic in cigarette use; the number of students that reported ever trying smoking was down from 45% of grade 6-9 students in 1994 to 13% in 2012. Researchers noted the use of water pipes, hookahs, and e-cigarettes had experienced a concurrent surge in use. The most commonly-used substance was alcohol, followed by marijuana and prescription medications (especially pain relievers) most often secured by social sources such as friends and family.

Many studies have been conducted to identify which emotional and behavioural factors put an adolescent at a higher risk for smoking and alcohol use. Most risk factors are linked to familial and home environments (Table 1).

**TABLE 1: EMOTIONAL AND BEHAVIORAL FACTORS LINKED TO INCREASED ALCOHOL AND SMOKING RISKS**

| |
|---|
| Self-harmers[11] |
| Depression, peer use, reduced body satisfaction[12] |
| Decreased coping and problem solving skills[12] |
| Decreased parental monitoring and/or communication[12] |
| Reduced family involvement[12] |
| Fewer rules, non-authoritarian parenting style[12] |
| Parental use and/or sanction[13] |

One study looked at political climate and the relationship to adolescent drug, tobacco, alcohol use. On the basis of their findings they hypothesized that countries with less stringent substance regulation - citing Canada and the Netherlands - had a higher incidence of adolescent drinking and drunkenness.[14] It should be noted, however, that Fang et al. did not link adolescent use to household, acculturation, or academic achievement.[12]

## Risks of alcohol and cigarette use

Decision-making in adolescents has been widely researched. Results of studies suggest that the development of cognitive reasoning skills depends on many factors. These include individual emotional development, perceived risk and maturity, the sum of which may have a direct effect on an adolescent's decision to use tobacco or alcohol. The risks of those decisions are summarized in Table 2.

Each of these developmental and behavioural risks carries with it a set of negative outcomes and other associated factors. As healthcare providers, our main concern is often with health factors, including HIV infection, premature mortality, cancer risk, and cardiovascular disease. 'Risky behaviour' is an umbrella term used by researchers that encompasses a variety of additional behavioural factors, such as younger than average age of first sexual experience, drug use, failure to use condoms, illicit drug usage and binge-drinking.[23-26]

**TABLE 2: RISKS OF ALCOHOL AND CIGARETTE USE**

| |
|---|
| Risky behaviour, binge consumption, road crashes, pregnancy, violence[15] |
| Later problems such as employment, HIV infection[16] |
| Premature mortality[17] |
| Depression[18] |
| Cardiovascular disease[19] |
| Decreased lung function[20] |
| Total cancer rates increased[21] |
| Unknown risks of e-cigarettes[22] |
| Violence and aggressive behaviour[23] |

Demographic factors related to high-risk groups include family dynamics (notably parental use of drugs, alcohol and tobacco, and family involvement/closeness) and first age of drug and alcohol use. Knowledge of these factors is a powerful tool for primary care providers, affording us lines of questioning to use when screening and monitoring adolescents.

**Smoking in Canada – Timeline**

| | |
|---|---|
| **1964** | 50% of Canadians aged 15 and older smoke. Sixty-one per cent of men are smokers |
| **Early 1990s** | Minimum age of 19 years-old for smoking set by the Canadian provinces |
| **Mid 1990s** | Ban begins on sale of tobacco in pharmacies |
| **Late 1990s** | Ban begins on smoking in restaurants |
| **2014** | 16% of Canadians smoke. |

**Source:** http://globalnews.ca/news/1074275/50-years-after-history-making-report-canadian-officials-reflect-on-anti-smoking-efforts

## Effects of EMF: mobile phones, electronic devices and adolescents

Technology has made a significant impact on our daily lives. Children are exposed to mobile phones, computers and handheld electronic devices from an early age, which is a stark contrast to previous generations. Homes, schools and even public spaces are equipped with the latest technological devices, exposing children to radio frequency (RF) and electromagnetic frequencies (EMFs) constantly. Current research on the effect of mobile phone and other electromagnetic devices on behavior, sleep, obesity, and cancer risk in adolescents is growing and the early results are alarming.

## Sleep, Behavior and Obesity

Research shows EMFs have an effect on biochemical rates in the hypothalamic-pituitary-gonadal axis and have been shown to affect circadian rhythm and disrupt melatonin.[27] An animal study revealed that rats exposed for three weeks to uniform 60-Hz electric fields of 39 kV/m (effective field strength) failed to show normal pineal gland circadian rhythms in serotonin N-acetyl transferase activity

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and melatonin concentrations. The effect was reversible within three days of cessation of field exposure.[28]

Studies have been conducted on the effect of electronic devices on sleep and behaviour in adolescents. Having electronic devices in the bedroom has been associated with sleep disturbance. According to the National Sleep Foundation's 2006 "Sleep in America Poll", almost all American adolescents (97%) had at least one electronic media device in their bedroom.[28,29] These items included such things as music players (90%), televisions (57%), videogame consoles (43%), mobile (42%) or fixed-line telephones (34%), computers (28%), and internet access (21%). Older adolescents had more media devices in their bedrooms than younger adolescents, with a median of two devices for 6th–8th graders and four devices for ninth- to twelfth-graders.[29,30]

According to the same study, adolescents with an increased number of electronic devices in their bedrooms slept significantly less during the week, experienced more daytime fatigue, and were more likely to drink caffeinated beverages during the day. The presence of a computer or electronic gaming console in a child's or adolescent's bedroom has been associated with an increased prevalence of disorders of bedtime resistance, delayed sleep onset, sleep anxiety, parasomnias and sleep disordered breathing. Mobile telephones in bedrooms pose additional problems as they also alert the individual to incoming calls or text messages.[29]

A Canadian study involving 502 pre-adolescent children between the ages of 9 and 11 years, from Ottawa, Ontario, found that children with two or more screens in their room, e.g., TV, computers and game consoles, had a lower quality of sleep. Additionally, children with a TV in their room had a significant increase in adiposity compared to those with no screens in their room. Interestingly, presence of a computer in a child's room was not associated with increased adiposity compared to no screen in the room.[30] While those children with an increased number of screens had an increase in screen time, there was no difference in the total sedentary time between groups.[30]

There is a direct correlation between time spent watching TV or playing video games and later bedtimes, delayed sleep onset, shorter sleep time, and increased day-time fatigue.[30] Furthermore, it is important to distinguish between violent and non-violent games, as it appears that playing non-violent games in the evening may produce positive effects on sleep.[30] Music can also influence sleep. In a recent study, 42% of American adolescents reported listening to music after 9 PM, and National Sleep Foundation reported that 90% of adolescents have a music player in their bedroom. In an experimental study involving fifth-grade students, participants were randomly allocated to either receive sedative classical music at naptime and bedtime for three weeks or not to receive music during this time. The children in the experimental group were also instructed to perform relaxation techniques such as monitor their breathing and relax their muscles while listening to music. Children in the experimental group had better sleep quality, sleep efficiency and duration than those in control group.[30]

Sedentary lifestyle and poor dietary habits (increased intake of fat and sugar and inadequate intake of fruits, vegetables and whole grains) have led to excess body fat in children and adolescents. In Canada, roughly 25% of children and adolescents are overweight or obese.[31] Excess body weight contributes to various chronic diseases, and to negative consequences on psychological health, self-esteem and cognitive development.[32-35] In 2008 a Canadian study by Yun Wu *et al* surveyed 3,421 grade-five students and their parents from 148 randomly selected schools in Alberta. Students completed the Harvard Food Frequency Questionnaire, questions on physical activities and had their height and weight measured. Parents completed questions on socio-economic background and children's lifestyle. The results showed that students with better quality diet, increased physical activity levels and normal body weight had a statistically significant improved health-related quality of life compared to students who had less healthy diets, were less active or were overweight or obese.[32] This type of study is further evidence of the importance of healthy eating and active living programs at school and home.

**Recommendations:**

- Keep technology out of bedroom
- Limit television viewing among children and adolescents to two hours per day
- Limit time playing computers or electronic games to two hours per day
- Choose less violent games
- Promote listening to soothing music closer to bed time
- Promote an active lifestyle and healthy dietary options

## Cancer risk

In 2011, the World Health Organization, International Agency for Research on Cancer (IARC) advised that electromagnetic radiation from mobile phone and other wireless devices constitutes a "possible human carcinogen".[36] Furthermore, other studies revealed that the risk of a brain tumor is significantly elevated for those who have used mobile phones for at least a decade. Studies carried out in Sweden indicate that those who begin using either cordless or mobile phones regularly before age 20 have greater than a fourfold increased risk of ipsilateral glioma.[36]

Empirical data have shown a difference in the dielectric properties (measure of permittivity and conductivity) of tissues as a function of age, mostly due to the higher water content in children's tissues.[36] High resolution computerized models based on human imaging data suggested children are indeed more susceptible to the effects of EMF exposure at microwave frequencies.[36]

The America Academy of Pediatrics issued a letter to the U.S. Congress on December 12, 2012 stating:

*"Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into*

*their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."*[36]

Although some research may have been inconclusive on cause-effect relationship between use of mobile phone and brain tumor development, there is enough evidence to warrant concern and demonstrate the need for further long-term studies beginning in childhood. There is also need for precautionary measures to reduce RF-EMF exposures of children and adolescents in particular.

A growing body of evidence on the dangers of RF-EMF exposure from mobile phone is leading manufacturers to take measures and develop ways to reduce radiation exposure.[36] One of the fastest growing mobile apps is called "tawkon", which provides an algorithm indicating the potential danger from signal strength to a mobile phone user. Globally, sales of cases and headsets tested and confirmed to reduce radiation have grown, indicating market demand for such devices. Mobile phone manufacturers are also issuing advice on reducing exposure.[36]

**Practical advice for the public as suggested by Davis et al:[36]**

- When it comes to using electronic devices, hold the phone at a distance.
- Follow guidelines suggested by your mobile manufacturer.
- Do not hold a cellphone directly up to your head. Use a headset or speakerphone when using the device, or a non-metal case that has been independently tested to reduce radiation up to 90%.
- Pregnant women should keep cell phones away from their abdomen and men who wish to become fathers should not keep these phones on while in their pocket.
- Do not allow children to play with or use cell phones. Older children should use a headset or speakerphone when talking on a cell phone.
- Do not text and drive, and only use specially adapted antennae when using mobile phones in cars to avoid absorbing maximum power as the phone moves from one cell system to another. When buying a new car, select one that has a built-in antenna that reduces your direct exposure.
- Turn off your wireless router at night to minimize exposure to radiation.
- Eat green vegetables and get a good night's sleep in a dark room to enhance natural repair of DNA that may have been damaged by radiation.

## Conclusion

There are several health concerns unique to the adolescent patient population. Ample evidence exists that proper nutrition and physical activity promote healthy bone development in childhood and adolescents. Social and behavioural factors have a significant impact on choices surrounding drug and alcohol use, and appropriate screening and support is indicated to encourage adolescents to make healthy choices. Responsible use of technology and reduction of EMF exposure is highly advisable given the serious effects they can have on young growing bodies.

## About the Authors

**Dr. Tannaz Mokhtari,** ND graduated from Canadian College of Naturopathic Medicine in 2003. She has a special interest in bioidentical hormone treatment and has published a review paper on this topic. She practices in a medical multidisciplinary clinic in Richmond Hill, specializing in digestive and hormonal health as well as pain management.

**Dr. Sarah Penney,** ND is a naturopathic doctor practicing in Hamilton, Ontario. She has also completed her Masters in nutritional sciences and focuses on women's health, digestive concerns and lifestyle counselling. She contributes freelance health and wellness articles to a variety of publications, and can be reached at Sarah.PenneyND@gmail.com.

**Dr. Gayle Maguire,** BSc, ND graduated from Canadian College of Naturopathic Medicine and practices in Calgary. She treats primarily pediatrics and fertility cases and teaches medical sciences at The Canadian Institute of Traditional Chinese Medicine.

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# 2015 Review of the Health Status of Canadian Adults

*Ownership and action are required to stop rising trends in disease*

**Dr. Laura M. Brown,** BGS, ND, **Dr. Poonam Patel,** BSc, ND, **Dr. Camille Sahula**, BSc, ND

It is evident that the most critical, chronic diseases are largely preventable and inextricably linked to one another. A 2015 review of the health status of Canadian adults is alarming. There is a three-fold increase in rates of obesity over the past five decades and a doubling in diabetes over the past thirty years.[1,2] The leading causes of death in Canada are cancer and cardiovascular disease.[3] This article will explore how and why adults in Canada need a higher level of ownership and an actionable plan for their state of health.

It is evident that the most critical, chronic diseases are largely preventable and inextricably linked to one another. A 2015 review of the health status of Canadian adults is alarming. There is a three-fold increase in rates of obesity over the past five decades and a doubling in diabetes over the past thirty years.[1,2] The leading causes of death in Canada are cancer and cardiovascular disease.[3] This article will explore how and why adults in Canada need a higher level of ownership and an actionable plan for their state of health.

The Framingham Heart Study (FHS), a longitudinal, multi-generational cohort study of cardiovascular disease (CVD) and its risk factors in Framingham, Massachusetts, USA, demonstrated that a rise in obesity rates causes a rise in the rate of type two diabetes (T2DM), which in turn increases the prevalence of CVD and death.[4,5] Pre-diabetes is also associated with risk for CVD, indicating that T2DM and CVD may share a common pathogenesis.[4,6] Obesity, diabetes and physical inactivity are also associated with increased incidence of cancer.[3] Levels of vitamin D are inversely associated with cardiovascular disease, T2DM and cancer.[7] Circadian rhythm dysfunction and lack of quality sleep is associated with breast, colon, prostate and endometrial cancers.[8] The disruption of melatonin production is clearly linked to cancer incidence.[8] Exposure to exogenous estrogen, namely from endocrine disrupting chemicals (EDCs), begins *in utero* and early life and may initiate the increased risk for cancer,[9,10,11] obesity,[12,13,14] diabetes, metabolic syndrome and cardiovascular disease[14] later in life.

This article reveals trends over the past 30 years and identifies connections among chronic diseases that better direct patient care. Important to the health of Canadians are quality of sleep, a healthy diet, preventative exercise, adequate levels of vitamin D and reduced exposure to endocrine disrupting chemicals.

**KEY FACTS**

**In Canada:**

- Obesity has risen 3-fold over past 50 years
- Diabetes incidence has doubled over the past 30 years
- 2 in 5 Canadians will be diagnosed with some form of cancer in their lifetime
- 89% percent of Canadians who develop cancer are over 50 years of age.

**Insomnia, obesity, cardiovascular disease, diabetes and cancer are variably linked through:**

- Increased level of screen time
- Exposure to EDCs
- Lack of physical activity
- Adequate levels of vitamin D
- Melatonin and circadian rhythm dysfunction

## Sleep

Sleep research grew with the publication and acceptance of the Pittsburg Sleep Quality Index in 1989[15] and the 1990 International Classification of Sleep Disorders (ISCD).[16] Over the past 30 years increased public and medical focus appears to contribute to the awareness of the rise of sleep disorders.[17] Since the late 1980s, research methods on sleep disorders have advanced in sampling methods and measurements,[18] and to add to the complexity of data analysis contributing causes of insomnia have also changed over the past 30 years.[17]

Despite the difficulty in accounting for confounding factors, in the United Kingdom three cross-sectional national mental health surveys (analyzed together) found a rise in sleep disorders.[17] Comparable sampling methods and identical insomnia assessments were conducted with 20,503 people aged 16-64 years in the United Kingdom in 1993, 2000, and 2007. Modest increases in insomnia prevalence were found over the survey periods: symptoms of sleep

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disturbance increased overall from 35.0% in 1993 to 38.6% in 2007 and insomnia diagnosis from 3.1% to 5.8%, respectively.[17] (Table 1) The more severe symptoms and definitions of insomnia correlated with female gender, unemployment and economic inactivity, lower levels of education, depression, and widowed, divorced, or separated marital status.[17]

**TABLE 1:**
**CHARACTERISTICS OF THE SAMPLES OF UK SUBJECT RESPONSES.**

| | YEAR OF SURVEY SAMPLE | | |
|---|---|---|---|
| | 1993 (N = 8903) | 2000 (N = 6175) | 2007 (N = 5425)[A6] |
| **Gender Female n (%)** | 4,728 (49.5%) | 3,392 (50.0%) | 3,059 (50.4%)[A7] |
| **Age mean (standard error)** | 38.2 (0.16) | 39.2 (0.22) | 39.7 (0.23)[A8] |
| **Employment status n (%)** | | | |
| In employment | 5,918 (69.0%) | 4,405 (75.0%) | 3,825 (72.6%) |
| Unemployed | 746 (8.5%) | 210 (3.2%) | 163 (3.5%) |
| Economically inactive | 2,220 (22.5%) | 1,525 (21.8%) | 1,428 (23.8%) |
| **Level of education n (%)** | | | |
| High | 2,930 (34.3%) | 2,360 (41.0%) | 2,484 (49.3%) |
| Medium | 3,177 (37.5%) | 2,012 (35.4%) | 1,631 (32.4%) |
| Low | 2,632 (28.2%) | 1,462 (23.6%) | 1,060 (18.3%) |
| **Depressed n (%)** | 226 (2.2%) | 197 (2.8%) | 178 (2.6%) |
| **Marital status n (%)** | | | |
| Married | 4,920 (59.5%) | 3,083 (54.1%) | 2,688 (51.4%) |
| Cohabitating | 569 (7.2%) | 615 (11.3%) | 591 (12.6%) |
| Single | 2,051 (24.2%) | 1,424 (24.7%) | 1,310 (27.0%) |
| Widowed | 307 (2.1%) | 181 (1.7%) | 168 (1.6%) |
| Divorced | 761 (5.3%) | 615 (5.8%) | 500 (5.3%) |
| Separated | 251 (1.7%) | 257 (2.6%) | 188 (2.1%) |
| **Total reporting taking hypnotic medication n (%)** | 54 (0.4%) | 62 (0.8%) | |
| **Reported taking hypnotic medication (within those reporting insomnia symptoms) n (%)** | 47 (1.1%) | 48 (1.7%) | |
| **Reported talking temazepam or nitrazepam n (%)** | | 20 (0.3%) | 14 (0.2%) |
| **Reported taking temazepam, nitrazepam or diazepam n (%)** | | 55 (0.7%) | 50 (0.8%) |
| **Insomnia symptoms n (%)** | 3,178 (35.0%) | 2,466 (38.0%) | 2.239 (38.6%) |
| **Insomnia of at least moderate severity n (%)** | 900 (9.3%) | 788 (11.5%) | 799 (13.2%) |
| **Insomnia and fatigue n (%)** | 1,034 (12.6%) | 909 (13.3%) | 862 (13.9%) |
| **Insomnia diagnosis n (%)** | 311 (3.1%) | 355 (5.0%) | 365 (5.8%) |

All percentages and means weighted.

Table re-printed from SLEEP 2012 Vol 35, P.379 with permission from Associated Professional Sleep Societies, Darien, IL.

The single greatest difference in Canadian life between 1985 and 2015 is the development and use of personal computers and cell phones. Personal computers were introduced in 1981. By 1997, 40% of Canadian households had a computer, and by 2006 that number was 75%. Internet access rose in the same period, from 17% to 68%.[18,19] One systematic review exists for the multitude of studies on screen time and sleep disturbance in adolescents aged fourteen to eighteen. It reviewed 67 studies published between 1999 and early 2014, from around the world, and divided studies into type of media included (e.g., television, computer, mobile phone, video gaming device). It concludes that 90% of published studies find a significant adverse association with at least one measured sleep outcome (primarily shortened duration and delayed timing) and increased screen time.[20] Note that such habits do not end at the age of eighteen.

Screen time has an adverse impact on sleep through the following four mechanisms:

1) It directly replaces sleep and sleep promoting activities like physical exercise;

2) Interferes with sleep through increased psychophysiological arousal due to the stimulating content of the media material;

3) Alters the circadian rhythm through bright light exposure from most electronic media devices[20] and

4) Leads to poor posture, causing musculoskeletal complaints, which correlate to poor sleep.[21]

It is important to identify these four mechanisms when screening patients of any age. While the studies do not give an indication of an acceptable amount of screen time per day, duration must be evaluated in the context of adequate sleep and physical activity.

Inadequate sleep time, whether formally diagnosed as insomnia or not, is an underlying factor for each of the chronic diseases discussed. Sleep restriction or fragmentation contributes to increased cortisol secretion and altered growth hormone metabolism, alterations in the sympathovagal balance, low grade inflammation, insulin resistance, decreased insulin sensitivity, and reduced glucose tolerance.[22] These factors are distinctly involved in metabolic syndrome (MetS) and vascular dysfunction.[22] The National Health and Nutrition Examination Survey I (NHANES I) was an American longitudinal study designed to investigate relationships between clinical, nutritional and behavioural factors and subsequent morbidity, mortality, hospital utilization and changes in risk factors, functional limitations and institutionalization, among adults from twenty five to seventy-four years of age with a series of follow-ups spanning more than two decades.[23] NHANES I data analysis has indicated that individuals reporting ≤5 hours of sleep duration had significantly greater odds (OR, 1.47) of having incident diabetes over the 10-year follow-up period than those sleeping seven hours habitually.[24] There is also compelling evidence showing that limited sleep duration and insomnia are associated with elevated resting heart rate and hypertension, metabolic syndrome (MetS), cardiovascular disease (CVD), and T2DM.[25-29]

## Obesity

Short sleep duration affects circulating levels of leptin and ghrelin, which in turn increase appetite and caloric intake, reduce energy expenditure and impair glycemic control. This may lead to adverse health outcomes including obesity.[27,29-31] In a study of sixteen healthy participants, Calvin et al. demonstrated that sleep restriction was found to increase caloric intake with those randomized to sleep restriction (5.1 hours/night) by an additional 542 kcal/day compared

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to a non-significant change of 118 kcal/day in the control group (6.9 hours/night).[32] Consider the calculation of calories accumulated in the sleep-restricted group amounted to an additional 56.4 pounds per year.

Framingham Health Study (FHS) investigators have reported that the rate of obesity increased more than 3-fold over the past 5 decades and the incidence of T2DM has doubled over the past three decades,[1,2] particularly in those thirty-five to forty-four years of age.[33] The increasing prevalence of obesity, caused by various factors such as decreased physical activity, sedentary lifestyle and obesogenic dietary patterns, contributed to the rising rates of hypertension and diabetes.[2] In Canada, the cross-sectional National Population Health Survey of 1994 and 1996, and the Canadian Community Health Survey in 2001, 2003 and 2005, found that heart disease and such risk factors as hypertension, diabetes and obesity, increased in all age groups and were increasingly prevalent among younger people.[2]

## Physical Exercise

Canada's adult guidelines and the World Health Organization (WHO) recommendations state that adults should incorporate 60 minutes of daily physical activity, or 150 minutes/week [30 minutes of moderate to vigorous physical activity (MVPA) on at least 5 days / week]. There is strong evidence that this will reduce the risk for CVD related events and mortality, hypertension and T2DM.[34] Only 5% of Canadian adults currently achieve this exercise criteria.[35] Greater health benefits appear to occur with higher volume and/or greater intensity of activity, but health benefits may also occur with as little as one hour of brisk walking per week.[34,35]

In the Diabetes Prevention Program (US) study with 3,234 high-risk non-diabetic participants, lifestyle intervention (including at least 150 minutes/week MVPA) was found to be more effective than metformin alone (850 mg bid), and reduced the incidence of diabetes over a 2.8 year follow-up by 58% and 31%, respectively.[36] Over a 3-4 year period, modest weight loss via diet and physical activity reduced T2DM incidence in high-risk individuals by 40-60%.[37] The Canadian Cancer Society reports that obesity, diabetes and physical inactivity also contributes to the national increase in uterine, thyroid and colorectal cancers.[3]

Exercise programs for diabetic patients should emphasize self-monitoring of glucose (SMBG) before, during, and after exercise, proper foot care (including type of shoe, type of exercise, inspection of skin surfaces and appropriate evaluation and treatment of lesions) and cardiovascular functional assessment (noting heart rate, blood pressure as well as ischemic changes or any underlying CVD, with further diagnostic testing as needed).[38] Resistance training of mild intensity should also be combined in an exercise program.[39]

## Endocrine Disrupting Chemicals (EDCs)

Significant worldwide differences in cancer incidence occur, and research demonstrates more industrialized regions are at higher risk of hormone-related cancers.[40] Canada is considered one of the top eight industrialized countries in the world.[41] Industrialized nations engage in more circadian rhythm disrupting behaviours such as night shift work, use of EDCs, and potentially increased screen time because of the nature of higher technology use in these regions.

The disruption of melatonin, the hormone responsible for circadian clock function, is clearly linked to cancer incidence.[42] Epidemiological and genetic evidence indicates that the orchestration of melatonin is responsible not only for the timing and function of cellular metabolic pathways of the circadian rhythm and the sleep-wake cycle, but also for immune function, cancer development and growth, the reduction of free radicals, mitochondrial respiration, cardiovascular function, bone metabolism, intermediary metabolism, food intake and digestion.[43] Melatonin clearly has a broader context than pineal gland initiated functions. Normal levels in the lower intestine are over 400 times greater than in the pineal gland.[43] Additionally, there appears to be a difference between the regulation of pineal gland melatonin and melatonin produced elsewhere in the body such as enterochromaffin cells, bone marrow cells, lymphocytes, mast cells and epithelial cells.[44] Human and animal studies indicate melatonin produced by the gastrointestinal enterochromaffin cells, unlike that produced in the pineal gland, is not regulated by light nor does it affect circadian rhythm.[43] Further investigation of the function and impact of endogenous and exogenous melatonin, and the role EDCs play in extra-pineal gland melatonin, is warranted and ongoing.

Circadian rhythm dysfunction is linked to the incidence of breast, colon, prostate and endometrial cancers. Use of EDCs also affects circadian rhythm.[3] For example, cadmium (derived from nickel–cadmium battery manufacture, pigments, and plastic stabilizers) with what is considered a low dose EDC, is shown to induce changes in the 24-hour pattern of pituitary circadian clock gene expression and plasma prolactin (PRL), luteinizing hormone (LH), thyrotropin (TSH), and corticosterone levels in animal models.[42]

EDCs can compromise the normal function of vascular endothelial cells by activating oxidative stress–sensitive signaling pathways and subsequent pro-inflammatory events critical in the pathogenesis of atherosclerosis and CVD.[45] Among participants in the NHANES study, significant associations were found between serum concentrations of EDCs, and the prevalence of metabolic syndrome (high waist circumference, elevated triacylglycerol, low HDL-cholesterol), hypertension and cardiovascular diseases, and diabetes (impaired glucose tolerance) even after correction for age, sex, race and ethnicity, poverty, income, BMI, and waist circumference.[46]

## EDCs and the Liver Enzyme Connection

In a 2014 population-based cross-sectional study, Kumar et al. demonstrated that various EDCs were associated with the liver dysfunction biomarkers bilirubin, ALT and ALP, suggesting adverse effects on liver function from these environmental pollutants, although no such association with GGT was found.[47] However, analysis of results from the NHANES follow-up from 1999-2002 involving 2016 people all at or above twenty years of age support that serum GGT, within its routine reference interval, may be a

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biomarker reflecting the extent of exposure to EDCs.[46] In relation to cardiometabolic disease, research demonstrates graded elevations of serum GGT (within the clinically normal range) are associated with increased risk of incident T2DM (related to insulin resistance), hypertension and cardiovascular events.[48,49] While GGT alone has inadequate sensitivity to be used as a screening tool in the clinical management of diabetes or hypertension, GGT (irrespective of alcohol consumption or liver damage) may be validated as a biomarker of environmental pollutant damage and oxidative stress related to the pathogenesis of cardiovascular and metabolic disease in the future.[45,48,49]

## Hormone Based Cancers

It is expected that 2 in 5 Canadians will develop cancer in their lifetime and 89% of those diagnosed are over the age of fifty.[3] Skin cancer, comprised of melanoma and nonmelanoma, is the most predominant cancer in Canada.[3] Melanoma is the most deadly form of skin cancer, however, the five year survival rate is 85% for men and 92% for women.[3] The remaining 52% of cancers diagnosed in Canada have an average survival rate of sixty three percent.[3] The six most likely causes of cancer death include lung, colorectal, breast, and prostate and pancreatic cancer.[3] The top three deadliest forms of cancer are pancreatic, esophageal and lung.[3] The cancers covered in this article are those that are hormone based, namely colorectal, breast, prostate, pancreatic, testicular, thyroid, and uterine.

### *Breast*

One in nine Canadian females will be diagnosed with breast cancer in their lifetime and most are diagnosed between the ages fifty to sixty-nine.[3] Exposure to endocrine disrupting chemicals,[9-11] unopposed exogenous estrogen in hormone-based therapies,[3] and prolonged exposure to endogenous estrogen[3] are all linked to breast cancer. The potential impact of EDCs derived from pharmaceuticals, industrial and agricultural sources, and beauty products are significant. When hormone replacement therapy use declined around 2002, so too did the incidence of breast cancer.[3] The incidence of breast cancer has since stabilized.[3] The transcutaneous absorption of chemicals found in cosmetics leads to measurable levels detected in human breast tissue.[50] A 2008 cell line study linked EDCs and breast cancer by demonstrating malignant transformation in breast cells exposed to the pesticide hexachlorobenzene;[51] the organophosphorus pesticides malathion and parathion,[52] PCBs,[53,54] bisphenol A,[55,56] cadmium,[57] butyl benzyl phthalate,[58] organochlorinepesticides,[59] benzyl salicylate, benzyl benzoate, butylphenylmethylpropional[60] and nitrite.[61]

### *Testicular*

Testicular germ cell tumours (TGCT) are the most common cancers in men in the fifteen to forty-four age bracket.[3] TGCT incidence has increased significantly over the past thirty years with little understanding of etiology. We do know *in vitro*, *in vivo* and human genotoxicity studies indicate that pesticides, notably the nematicide 1,2-Dibromo-3-chloropropane (DBCP), are capable of acting as a testicular mutagen and clastogen.[62] Pesticides, a type of EDC, can remain present in soil and groundwater and are difficult to remove.[63] The incidence of testicular cancer is higher in those born during time of use of phosphorous and nitrogen based fertilizers as indicated.[63] When consumption of phosphorous based fertilizers declined in Norway and Denmark in World War II years (1941-1945), so did the incidence of testicular cancer for those born in this time frame. A multi-register cohort study for those born and raised on Norwegian farms between 1952-1991, found an increasing incidence of testicular cancer in offspring born in areas of intense nitrogen and fertilizer use.[63] Efforts should be made for surveillance and attention to those with a history of born and raised in agricultural regions where pesticides and fertilizers have been and are currently in use.

### *Thyroid*

The incidence of thyroid cancer is rapidly increasing, with a rise of 4.3% in women from 2005-2010 and 6.2% in men since 2001.[3] The risk factors for thyroid cancer are largely unknown as stated by the Canadian Cancer Society.[3] However cell studies indicate phthalates, another type of EDC, are known to act as peroxisome proliferator-activated receptors (PPAR) activators and thyroid hormone axis antagonists or antiandrogens.[64] EDC exposure is associated with an increase in the risk of thyroid or hormone based cancers.

### *Colon*

Colorectal cancer rates have remained relatively stable in Canada since the mid 1990s;[3] however incidence continues to be higher in Canada than other industrialized nations.[65] In a 2002 human study twelve Polish women and twenty-one Polish men aged forty-seven to sixty-nine diagnosed with colon cancer showed a significant decrease in the peaks of their melatonin secretion, as well as a reduction in overall melatonin production.[66] The causal relationship of the correlation between colon cancer and the pineal gland, or the enterochromaffin cell production of melatonin, or melatonin disruption warrants further investigation.

### *Uterine*

The incidence of uterine cancer has risen 2.6% since 2006.[3] Human epidemiological data analysis suggest that prolonged exposure to unopposed estrogen through HRT, early menarche, or late menopause appears to increase the risk for uterine cancer.[3] Additional risk factors include a body mass index >25, diabetes, genetic predisposition, endometrial hyperplasia, chronic anovulation, previous pelvic radiation, estrogen-secreting ovarian tumours and hereditary non-polyposis colon cancer (HNPCC).[3]

### *Prostate*

After lung and colorectal cancer, prostate cancer is the next leading cause of cancer death in Canadian men.[3] Risk factors for lethal prostate cancer include smoking, high levels of testosterone, high intakes of dietary calcium, deficiency of vitamin D, decreased intake of antioxidants (vitamin E, selenium and lycopene), obesity, African American descent, family history of prostate cancer, age between sixty and sixty-nine, and lack of physical activity.[67] Animal models show EDCs are linked to prostate cancer especially when there is

exposure in utero, neonatal or during puberty. EDCs can act as an Estrogen Receptor (ER) ligand, which ultimately affects estrogen levels, steroid metabolism, prostate differentiation patterns, and cell proliferation.[68] Specifically identified EDCs affecting the prostate include cadmium, diethylstilboestrol, PCBs, ultra violet filters (sunscreen), bisphenol A, and arsenic.[68]

### *Pancreatic*

Although pancreatic cancer is rare in Canada, it is the deadliest cancer, with a five-year survival rate of 8%.[3] A 2012 review by the Johns Hopkins University revealed smoking was attributed to 25% of pancreatic cancer cases. Additional risks also include age over forty-five, family history of pancreatic cancer, obesity, high-fat diet, lack of exercise, consuming more than six alcoholic drinks per day, and diabetes.[69] Lifestyle and diet are major preventable factors in pancreatic cancer risk.

## Cancer Prevention & Treatment

It is estimated that 33% of cancers could be prevented with a diet high in vegetables and fruits, healthy BMI and regular physical activity.[70] In fact, higher rates of cancer correlate with higher rates of obesity and decreased physical activity in the same regions of Canada.[3] Other major ways to reduce cancer risk include reducing alcohol intake,[71] avoiding use of tobacco and reducing exposure to environmental and occupational carcinogens, including EDCs.[65] There are diverse opinions on responsible exposure to sunlight and UVB rays and the use of sunscreen, some of which may contain xenoestrogens.[7] Levels of vitamin D are inversely associated to chronic diseases including cardiovascular disease, T2DM and cancer.[72] Skin types, latitudes; times of year and types of sunscreen make it difficult to ascertain the exact amount of sun exposure that is safe.[72] Prescribing vitamin D as a supplement, according to the individual's vitamin-D status, may be the safest way to assure that adequate amounts of vitamin D (>74.88 nmol/L)[72], are achieved without risking melanoma.

## Summary

At least 33% of the chronic diseases discussed in this article are preventable. Understanding the complex interrelationships as well as the subtle specifics will help us to educate ourselves and others on the foundations of healthy lifestyles. Interestingly, a significant common denominator for prevention of T2DM, CVD, and hormonal cancers is sleep itself, at seven hours per night, uninterrupted, as well as reductions in circadian rhythm disturbances due to light and EDCs.

Protection of health comes not only from through a whole food, high vegetable based diet, but also through reduced screen time, adequate sleep, regular physical activity, safe sources of acquiring vitamin D, and a reduction of exposure to endocrine disrupting factors which can act indirectly as obesogens and circadian rhythm disruptors, or directly as carcinogens. With knowledge of these facts comes the responsibility to educate, to stop the rising trends predicted for the next thirty years.

## About the Authors

**Laura M. Brown,** BGS, ND, is the founder of Naturalaura Health (www.naturalaura.ca) and practices in Guelph. Laura is a catalyst for change and is passionate about reducing the risk factors of cardio-metabolic disease. Laura received her Bachelor of Arts and Science with distinction from Athabasca University, and Bachelor of Naturopathic Medicine from Canadian College of Naturopathic Medicine (CCNM). While on internship at CCNM, Laura received additional training in caring for people living with cancer. Laura is a member of the Canadian Association of Naturopathic Doctors, Ontario Association of Naturopathic Doctors and the Oncology Association of Naturopathic Physicians.

**Poonam Patel,** BSc, ND received her Biology degree from the University of Toronto and her Naturopathic diploma from Canadian College of naturopathic Medicine (CCNM). She currently practices in Mississauga and Etobicoke with special interests in gastrointestinal health, endocrine disorders, women's health and fertility as well as mental health. She is passionate about education and prevention with her patients, and is a part-time faculty member at CCNM and supervisor for fourth-year interns at the Robert Schad Naturopathic Clinic. She also completed her Fellowship in Homeopathic Medicine at the Canadian College of Homoeopathic Medicine and is a member of the Canadian Association of Naturopathic Doctors and Ontario Association of Naturopathic Doctors.

**Camille Sahula,** BSc, ND received her Bachelor's degree from the University of Toronto, with honours, with a double major in Human Biology and English Literature, and her Bachelor of Naturopathic Medicine from the Canadian College of Naturopathic Medicine (CCNM). She received additional training in pediatric care during her clinical internship at CCNM, and is looking forward to becoming IV certified when proclamation goes through in Ontario. Camille practices at HealthSource Integrative Medical Center, based in Kitchener. She is a member of the Canadian Association of Naturopathic Doctors and Ontario Association of Naturopathic Doctors.

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# Chronic Disease in Our 'Baby Boomer' Generation

**Dr. Melissa Lee,** ND, and **Dr. Andrea Hornyak,** ND

In 2011 it was estimated that as early as 2015, the Canadian 'baby boomer' generation ('boomers,' or those over the age of 65) will outnumber those under 14 years of age. It is also estimated that boomers will account for approximately 25% of the Canadian population by 2036.[71] As the boomer generation is living longer than previous generations, healthcare providers need to be prepared for the chronic diseases associated with this aging population.[71] This paper explores how arthritis, Hepatitis C (HCV), and human immunodeficiency virus (HIV) are affecting this generation and how naturopathic doctors can best treat these chronic diseases.

## Arthritis

Arthritis is the most widespread chronic affliction affecting North Americans aged 65 and older.[1] Arthritis is comprised of more than one hundred rheumatic diseases[2] and affects approximately 4.6 million Canadians.[3] It is predicted that in the next twenty years, one in five Canadian adults will be living with arthritis.[2]

Arthritis is diagnosed by cartilage breakdown and inflammation in joints that is generally worse with movement and long periods of inactivity. Rheumatoid arthritis is an immune-mediated systemic inflammatory joint disease affecting approximately 1 out of every 100 Canadians.[27] Osteoarthritis, the most common type of arthritis, is a degenerative disease process affecting 1 in 10 Canadians.[28] Other common categories of arthritic diseases include ankylosing spondylitis, fibromyalgia, gout, juvenile idiopathic arthritis, psoriatic arthritis, Raynaud's phenomenon, Sjogren's syndrome, and systemic lupus erythematosus.

The most common manifestations of chronic arthritis include joint pain, stiffness and edema, all of which can impede the ability to carry out activities of daily living and are a leading cause of disability claims in Canada. People who have been diagnosed with arthritis have a substantially decreased quality of life compared to individuals who do not have the disease.[4] More than 59% of Canadians with arthritis experience a reduction of activities, which is twice the rate of reduction of activities caused by other chronic conditions.[5] Older adults with arthritis experience greater stress caused by pain and impairment. Considering arthritis produces functional limitations, it is possible that the disease has an 18% correlated risk with major depression.[6] According to the Canadian Arthritis Society, adults with arthritis are a third more likely to report having deficient mental health or depression and anxiety disorders compared to a person with other chronic conditions, and three times more likely to suffer from these mental health issues than someone without a chronic illness.[2]

Current baby boomer obesity rates have more than doubled compared to the previous generation.[7] Stress on the body caused by being overweight increases the probability of developing knee osteoarthritis, and thus the likelihood of joint damage. The mechanism by which obesity is associated with arthritis is presumably due to both metabolic and mechanical stress.[5]

The degradation process of arthritis may be initiated due to an injury or overuse, but can progress due to excessive mechanical load or oxidative stress, as free radicals generate inflammation and arthritic disorders. The percentage of people between the ages of 55 and 70 years with underlying concomitant diseases such as diabetes (47%), hypertension (44%) and obesity (31%), appear to be especially susceptible to developing arthritis.[8] Canadians living with arthritis have a fourfold greater chance of cerebrovascular accident.[9] Moreover, the probability of developing a new cardiovascular event such as heart disease, stroke, or deep vein thrombosis is correlated with the presence of arthritis, diabetes, hypertension and triglyceride level.[10]

The burden of the onset and deterioration of arthritis takes into account various elements, which in turn contribute to chondrocyte senescence. For example, accumulation of toxicity is more common now than ever due to several dietary and lifestyle factors and increased environmental toxins, inflammation and stress. As the body's detoxification pathways naturally deteriorate over time, it is possible that a decreased toxin clearance will contribute to the increasing prevalence of arthritis in older adults.

### *Dietary Factors*

Dietary factors associated with the exacerbation of arthritis include food sensitivities, food additives, the consumption of alcohol and regular high sugar intake. Alcohol use raises the possibility of

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|---|---|
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| *Belladonna 1X | Reduces back pain |
| *Bellis perennisMT (M) | Relieves joint and muscle soreness |
| *Calendula officinalis MT (N) | Relieves pain |
| *Chamomilla MT (N) | Soothing pain relief |
| *Echinacea MT (N) | Relieves pain |
| *Echinacea purpurea MT (N) | Relieves pain |
| *Hamamelis virginiana MT (N) | Relieves joint and muscle soreness |
| Hepar sulphuris calcareum 6X | Relieves pain |
| *Hypericum perforatum 6X | Relieves pain |
| Mercurius solubilis 6X | Reduces joint and back pain |
| *Millefolium MT (N) | Relieves pain |
| *Symphytum officinale 4X | Relieves joint pain |

*1X=D1

| Active Ingredients | |
|---|---|
| **Each 50g contains:** | **Purpose** |
| *Aconitum napellus 1X | Reduces joint and back pain |
| *Arnica montana, radix 1X, 3X, 10X | Reduces joint and back pain |
| *Baptisia tinctoria 4X | Reduces joint and muscle soreness |
| *Belladonna 2X | Reduces back pain |
| *Bellis perennis 2XR | elieves joint and muscle soreness |
| *Calendula officinalis 1X | Relieves pain |
| *Chamomilla 2X | Soothing pain relief |
| *Echinacea 1X | Relieves pain |
| *Hamamelis virginiana 2X | Relieves joint and muscle soreness |
| *Hypericum perforatum 6X | Relieves pain |
| *Millefolium 2X | Relieves pain |
| *Ruta graveolens 4X | Relieves pain |
| *Symphytum officinale 4X | Relieves joint pain |

*1X=D1

MediNatura

These statements have not been reviewed by the Food and Drug Administration. They are supported by traditional homeopathic principles.

developing rheumatoid arthritis as it increases specific inflammatory markers preceding the development of symptoms.[11] Seropositive rheumatoid arthritis is also associated with daily consumption of soda-pop in women.[29] Particular food intolerances will provoke an immune response in 30-40% of individuals with rheumatoid arthritis[15] as it activates inflammation in the body.[12] The production of cross-reactive antibodies is remarkably increased in the gastrointestinal tract of many people with rheumatoid arthritis, as milk allergens and azo dyes have been found to be particularly harmful to this population.[13] Therefore, food sensitivities indicate an unfavorable additive effect of multiple hypersensitivity reactions mediated by immune complexes, which in turn leads to the promotion of autoimmune reactions in the joints.[14] The majority of double-blind placebo-controlled trials have demonstrated that approximately 40% of people with rheumatoid arthritis substantially improve by using an elimination diet to avoid foods that precipitate symptoms.[15] When arthritis is coupled with celiac disease, implementing a gluten-free, anti-inflammatory or alkaline diet is of great value.[16] Psoriatic arthritis is associated with an elevated prevalence of anti-gliadin antibodies, although improvement of symptoms as well as inflammatory laboratory measurements occur, regardless of celiac diagnosis.[23] Furthermore, an anti-inflammatory diet reduces the generation of antibodies and consequently pro-inflammatory cytokines. An IgG antibody blood test for food sensitivities is a valuable reference tool from which dietary modifications can be made to eliminate inflammatory triggers in the gastrointestinal tract.[17]

## *Lifestyle Factors*

The harmful consequences of obesity and smoking are extensively recognized in the literature. Smoking tobacco has been associated with an increased risk of rheumatoid arthritis.[5, 18, 19] Research done on older adults has shown that people with arthritis are predominantly less inclined to be physically active, as some believe it will aggravate symptoms, whereas others in this cohort genuinely do not know how to exercise properly. Individuals with osteoarthritis have diminished pain, increased tolerance to walking, and lessened depressive symptoms with moderate routine exercise. Achieving an acceptable body mass index alleviates direct mechanical stress on the joints, thus decreasing both symptoms and thus progression of arthritis. For example, in one study, weight loss of 10% significantly improved function of the knee by 28%.[20]

## *Environmental Factors*

The current baby boomers were exposed to Dichlorodiphenyltrichloroethane (DDT) and lead more than any other generation. Gasoline and paint as sources of lead are linked to osteoarthritis. Lead toxicity contributes to the structural deterioration of the knee joint through effects on bone and cartilage remodeling.[21] Toxic metals can also damage the immune system and contribute to autoimmune disease, namely rheumatoid arthritis. Heavy metal detoxification of aluminum, cadmium and lead with calcium disodium edetate (EDTA) once a week for a year has been shown to improve oxidation profile and disease symptoms.[22]

The development of rheumatoid and psoriatic arthritis tends to be linked to numerous combinations of environmental determinants, such as toxins and stress.[23] Stress is acknowledged as an influential risk factor for the commencement and modulation of rheumatoid arthritis via immune-system interactions. Several research conclusions state that chronic mild stress can lead to pro-inflammatory effects, thus increasing disease activity, which is also evident on the radiological presentation of disease advancement.[24] Therefore, coping methods to diminish the incidence of stress have a beneficial influence on chronic autoimmune conditions. Moreover, treating latent immune system debilitation in psoriatic arthritis and subduing environmental influences contributing to inflammation are both very effective at impeding further joint deterioration in autoimmune disease.[17]

## *Our Role as Naturopathic Doctors*

Dietary and lifestyle factors, environmental toxins, inflammation and stress all indicate a predisposition to arthritis in older age groups. This presents a critical aspect for targeted naturopathic interventions that support the prevention and management of this incessant disorder.

The naturopathic treatment of arthritis over the past 30 years has concentrated on pain management, enhancement of joint function, preservation of a healthy body weight and mental/emotional healing. Traditionally, a combination of the core naturopathic modalities has been utilized.

Regulating the stress response by including the mind-body connection is a vital component of a thorough treatment plan for arthritis, as the exacerbation of symptoms is correlated with the onset of particularly stressful life events. As shown in one study, individuals with psoriatic arthritis have a weakened hypothalamus-pituitary-adrenal feedback to stress.[17] Therefore, when cortisol levels are elevated, immunity is suppressed, and autoimmune conditions have a greater likelihood of developing.

The autonomic nervous system can be reset to pacify a stress reaction via deep breathing exercises.[17] A treatment program that incorporates meditation produces superior improvements in pain and quality of life.[25] Instructing an individual to associate with the present moment and identify their emotions can support the body through pain and fatigue caused by rheumatoid arthritis, ankylosing spondylitis, or psoriatic arthritis.[26]

To combat systemic inflammation, specific naturopathic therapies are highly valuable; Omega-3 fatty acid's eicosapentaenoic acid (EPA) and docosahexenoic acid (DHA) consist of prostaglandins and leukotrienes that inhibit inflammation. Additionally, both vitamin D and the *Lactobacillus casei* strain of probiotics influence the differentiation of T cells to become T regulatory cells. [17]

Nutraceutical recommendations should take into account the absorptive ability of the patient, possible sensitivities to additives, contraindications as well as nutrient deficiencies caused by

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pharmaceutical drugs; all of these factors are common in 55-70 year-olds. However, co-morbid chronic diseases, such as heart disease, diabetes and obesity make it more challenging to facilitate optimal health. Furthermore, the majority of older adults have been medicated over the years with NSAIDS, which only further worsen inflammation. Naturopathic medicine must therefore be directed at supporting the patient's vital force as well as preventing many of the concurrent conditions associated with this growing demographic. Prevention and expeditious treatment are imperative to limit the physical and emotional pain that arthritis can generate. Identifying the primary cause(s) of disease is essential to effectively improve the quality of life for a patient with arthritis.

## Hepatitis C Infection: A Growing Public Health Concern

The Hepatitis C virus (HCV) was first discovered in 1989 and now affects approximately 170 million people worldwide.[30] In Canada, the rates of HCV transmission have been decreasing; however, the diagnosis of chronic HCV infection in the baby boomer population continues to increase.[30, 31, 32, 42]

HCV is an enveloped, single stranded linear RNA virus belonging to the Flaviviridae family. There are seven genotypes of this virus of which strain-1 is the most prominent, causing HCV infections in North America and Canada specifically.[33, 34] Before 1989 it was primarily transmitted by injected drug users via needle sharing, drug abuse, blood transfusions, and medical treatment with unsterilized needles/equipment[32,34] and continues to be transmitted primarily through contact with infected blood.[2]

The course of disease for HCV infection can progress and manifest in several ways. Approximately 21% of people are unaware they are infected, 15-50% will spontaneously clear and recover from their infection,[35] 15% to 25% of those infected will develop cirrhosis, liver cancer or require a liver transplant[36] and about 50-85% of those who remain infected will progress to chronic infection and may remain asymptomatic for decades.[32, 37]

Since 1989, new screening strategies have been developed to detect anti-HCV antibodies and assess liver damage.[34, 38] These two factors have led to an overall decrease in transmission of the virus in Canada. However chronic infection still exists in the following high-risk groups:

1) Past or current injectable drug users represent the largest population of transmitters in Canada.[39, 40]
2) Canadians and Americans born between 1945 to 1975.[39]
3) Immigrants from other countries where HCV infection is common. This population accounts for approximately 20% of infected Canadians. [40]

Specifically the age group of 40-70 year-old baby boomers (1945-1975 birth cohort) remain at high risk for patient morbidity and mortality as shown in Figures 2 and 3.[39] In 2007, it was estimated 802 Canadians developed cirrhosis, 473 progressed to liver failure, 292 suffered from hepatocellular carcinoma, and 134 received a liver transplant, all due to HCV.[40-42] Not only are these sequelae expected to increase over the next ten years, but it is estimated that HCV related deaths will increase from 483 in 2007 to 613 in 2027.[32,39] The reason the 55-70 year-old population remains at high risk for morbidity and mortality is mainly due to late diagnosis and development of sequelaes of HCV: liver cirrhosis, liver cancer and extra-hepatic HCV related diseases.[32, 34, 39]

**FIGURE 1. COURSE IF INFECTION[33]**

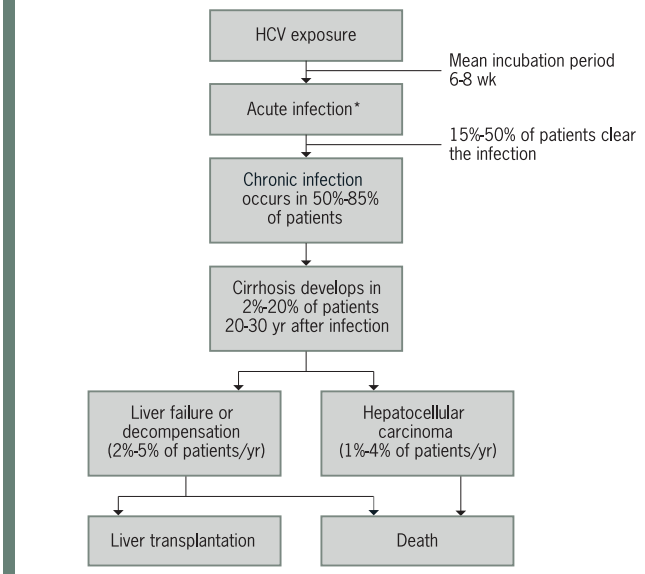





**FIGURE 2. AGE AND SEX DISTRIBUTION OF ANTI-HEPATITIS C VIRUS (HCV)-POSITIVE CASES IN CANADA, 2011[30]**

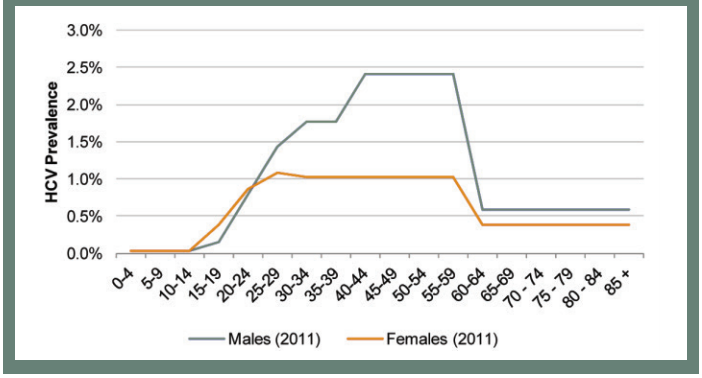
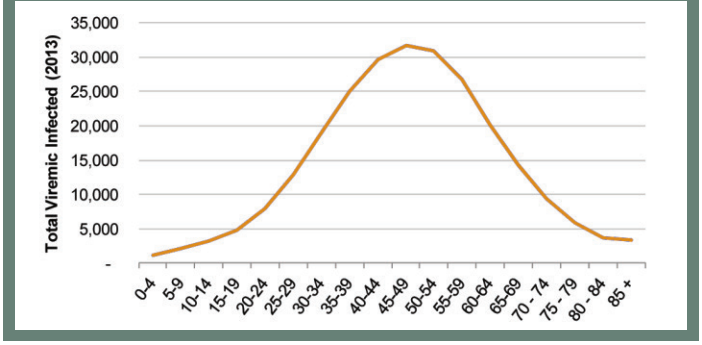



**FIGURE 3. TOTAL NUMBER OF VIREMIC HEPATITIS C CASES ACCORDING TO AGE, 2013[30]**





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The target of conventional treatment of HCV is to suppress viral replication or cure the viral infection.[38,43] Treatment efficacy is not considered completely successful as results vary from 50%-80% in "curing" HCV. "Curing" is defined as reaching sustained virologic response (SVR), which is being aviremic for 24 weeks after completion of antiviral therapy.[45, 46] One of the reasons why treatment efficacy is low is because diagnosis is often delayed; infected individuals remain fairly asymptomatic until liver damage is advanced. They typically present only when symptoms from decompensated cirrhosis or liver cancer develop. Delayed treatment increases the risk of HCV sequelaes.[39-42]

Furthermore, there are significant comorbidities that come with HCV infection. For example, approximately 30% of people with HCV will experience psychological conditions such as depression or anxiety, [44] a majority will suffer from fatigue [47, 48] and a number will experience cognitive impairment.[49] These symptoms may be present in the absence of liver damage.[44, 47-49] This is important to note because HCV infection can be overlooked as depression, fatigue and/or cognitive impairment are common in the 55-70 year old population. This variable is another contributing factor to delayed diagnosis.

## *Our Role as Naturopathic Doctors*

HCV infection among baby boomers was ranked the first of 51 pathogens contributing to the overall burden of infectious diseases in Ontario.[50] It is estimated that total health care costs associated with chronic HCV in Canada will increase by 60% between 2013 and peak in 2032 (estimated lifetime cost of HCV to be $64,694 per person).[41] Naturopathic doctors can help to decrease this healthcare burden.

The key to effective treatment is early diagnosis and early conventional and naturopathic treatment to reduce the likelihood of liver damage. The U.S. Centre for Disease Control (CDC) and Public Health Agency of Canada (PHAC) both recommend that anyone born between 1945 and 1975 undergo a mandatory one-time screening for HCV even in the absence of HCV risk factors.[32, 39, 40] With early detection of HCV and application of appropriate therapies, naturopathic doctors can help patients prevent the complications of HCV and improve overall health, ultimately reducing morbidity and mortality. Naturopathic doctors have many effective therapies for the treatment and management of Hepatitis C and it is important to clarify your treatment goals and direction with your patient. The following are guiding treatment principles for approaching a case of Hepatitis C.

1) *Early Detection*: Push for screening if your patient falls into any of the high-risk categories listed above, especially if they are within the birth cohort of 1945-1975 (See Table 1).[32]

2) Address any dietary and lifestyle concerns as obstacles to the healing process. For example, alcohol screening is often recommended in addition to the laboratory testing.[71]

3) *Integrative Management and Treatment* with an ultimate goal of preventing HCV infection from advancing to fibrosis, hepatocellular carcinoma, or liver transplant.[71]
   a. Reduce tissue damage, inflammation, and oxidation.
   b. Address the comorbidities of HCV infection: depression, anxiety, fatigue, pruritus, pain, gastrointestinal dysfunction, nausea
   c. Address treatment side effects of pharmaceutical medications: flu-like symptoms, pain, insomnia, depression, low blood counts and gastrointestinal symptoms.

4) *Monitor* disease progression, treatment efficacy, and patient response: CBC, liver function tests, viral load, and imaging (See Table 2).[39]

5) Support optimal liver function.[71]

**TABLE 1: HEPATITIS C SCREENING[32, 45]**

| VARIABLE | RELEVANCE |
|---|---|
| **Hepatitis C Antibody: Anti-HCV Antibody** | Results:<br>• Negative anti-HCV antibody + Immunocompetent person with no risk factors → No further testing required<br>• Positive anti-HCV antibody → HCV infection or previous infection with spontaneous remission. Proceed to HCV Nucleic Acid Test (NAT)<br><br>**Note: Ongoing/recent risk of HCV exposure or severely immunocompromised do routine screening (e.g., hospital workers). |
| **HCV Nucleic Acid test (NAT) (HCV RNA test)** | Two types of testing:<br>1. HCV NATS (for HCV viral load)<br>2. Qualitative NATs (for presence or absence of viremia).<br><br>Results:<br>• Anti-HCV antibody positive/indeterminate + positive HCV NAT = active acute or chronic HCV infection<br>• Anti-HCV positive + negative HCV NAT= non-active/resolved HCV infection |

**TABLE 2: LABORATORY SCREENING FOR HCV[39]**

| |
|---|
| CBC: testing for signs of anemia, neutropenia, thrombocytopenia (all side effects from conventional medications) |
| Prothrombin Time (PT), International Normalized Ratio (INR), Partial Thromboplastin Time (PTT) |
| Complete chemistry: AST, ALT, total and direct bilirubin |
| Imaging: to detect progression of liver disease |
| Assessing liver health: Iron, Iron binding capacity, ferritin |
| TSH/fT3/fT3: Patients on interferon treatment can develop thyroid issues. |
| Hepatitis A total antibody and hepatitis B core and surface antibodies to check for immunity |

## An Aging HIV Population

The Human Immunodeficiency Virus/Acquired Immunodeficiency Disease (HIV/AIDS) is a global public health issue that affects approximately 33-35 million people worldwide.[51] In 2009, approximately 1.8 million people died from AIDS and at the end of 2013, 2.1 million people were newly infected with HIV globally.[51, 52] HIV/AIDS has changed significantly in Canada over the past quarter century.

HIV is a retrovirus, with genotypes 1 and 2 primarily affecting the North American population.[54] These strains are transmitted through mucosal transmission (e.g., vaginal and rectal transmission account for most adult infections), and body fluid transmission of blood, breast milk, semen and vaginal secretions.[55, 56] The HIV virus targets specific subsets of T cells which leads to immune dysfunction and ultimately progresses to Acquired Immune Deficiency Syndrome (AIDS). It does this by three mechanisms:

1. Massive and early depletion of CD4+ T cells in the intestinal tract, which disrupts the expression of immune phenotypes, immune function, intestinal permeability, and alters the gut flora. These cause changes in immune homeostasis and alters the inflammatory response to HIV and other pathogens. [57, 58, 59, 60]
2. Infection and dysregulation of these mucosal CD4+ T cells also leads to intestinal damage, which activates the production of new CD4+ T cells for the virus to invade and replicate in.[58, 59, 60, 61]
3. Evasion of host immune responses through down regulating key host immunoregulatory molecules and inactivation of host proteins and antimicrobials.[61, 63]

Overall the course of disease involves symptoms of immunodeficiency: initial malaise, fatigue and fever, to opportunistic infections like candidiasis, oral herpes zoster and bacterial infections, to Kaposi Sarcoma, Burkitt Lymphoma, and more.[62,63]

In Canada, HIV/AIDS was first diagnosed in the early 1980s[53] (1981 in Montreal, Canada) in the gay male population and peaked in the mid-80s and early 90s.[52] Since then approximately 21,000 people in Canada have died while infected with HIV or AIDS. In 2012 the Public Health Agency of Canada (PHAC) reported that at the end of 2011 there were approximately 71,300 people living with HIV and AIDS, 25% of whom it is estimated were unaware of their infection. [52] From 1979 to December 2013, a total of 23,111 AIDS cases were reported (Figure 4). Canada's HIV/AIDS infections predominantly occur in specific populations. Although men who have sex with men continue to be the population most affected by HIV/AIDS, the disease is also a significant public health issue for injecting drug users, Aboriginal peoples, prison inmates, people from countries where HIV is endemic, as well as those already living with HIV/AIDS.[52,63] Specifically, 49.3% of all HIV cases in adults were attributed to men who have sex with men, 29.6% of cases were heterosexual males (which includes immigrants from an endemic country, or contact with a person at risk), and 12.8% of cases were injection drug users.

The trends of HIV and AIDS diagnosis in Canada is declining. The PHAC reports that as of the end of 2013, the majority of HIV diagnosis is in the 30 year old age range, followed by individuals >40 years of age (Figure 5).[52] In terms of AIDS diagnosis, at the end of 2013 the majority of AIDS cases in females were in the younger age ranges (20-29, 30-39), whereas AIDS diagnosis in males was in the older age ranges (30-39, 40-49, and +50) (Figure 6). Although there is no "high" prevalence of HIV/AIDS diagnosis in our baby boomer population currently, what we are noticing is that because of advances in treatment, people with HIV are now approaching life expectancy similar to uninfected populations.[64] Due to this aging population, we can anticipate seeing an increase in the number of people progressing from HIV to acquiring AIDS at an older age. As we notice these trends, we must prepare ourselves as healthcare providers to provide integrative support for these patients.

**FIGURE 4. NUMBER OF REPORTED AIDS CASES BY YEAR OF DIAGNOSIS – CANADA: 1979-2013[52]**

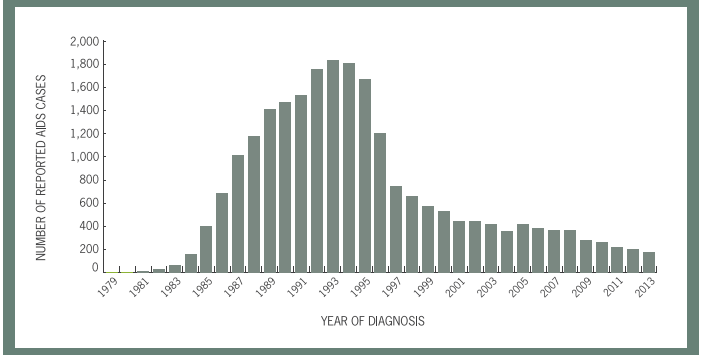





**FIGURE 5. AGE GROUP DISTRIBUTION OF POSITIVE HIV TEST REPORTS BY SEX – CANADA: 1985-2013[52]**

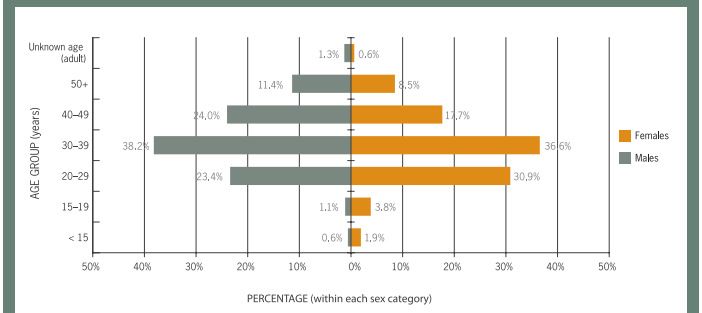
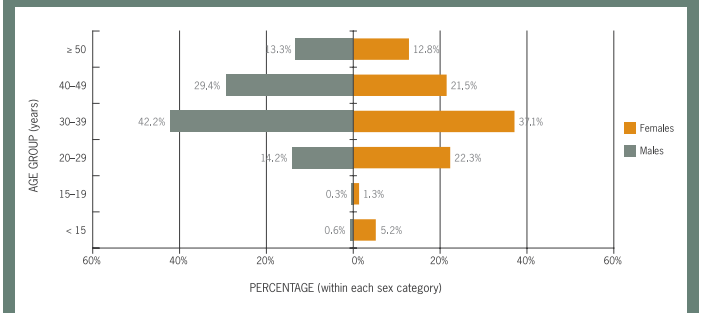




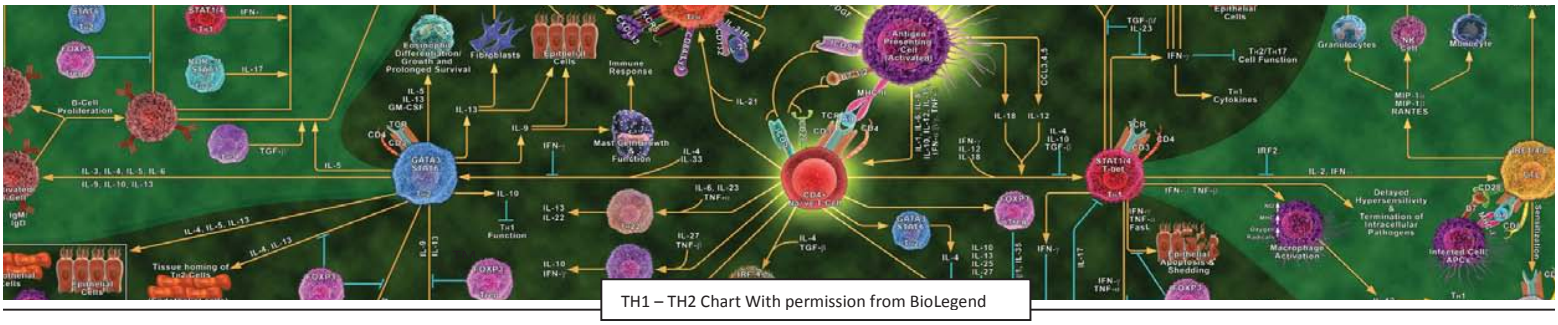

**FIGURE 6. PROPORTION OF REPORTED AIDS CASES BY SEX AND AGE GROUP – CANADA: 2013[52]**






## *Our Role as Naturopathic Doctors*

Conventional treatment of HIV continues to evolve and advance as the immunogenetics of HIV is further understood. The goals of current treatments has always been to suppress and control the proliferation of HIV and progression to AIDS, helping patients live



TH1 – TH2 Chart With permission from BioLegend

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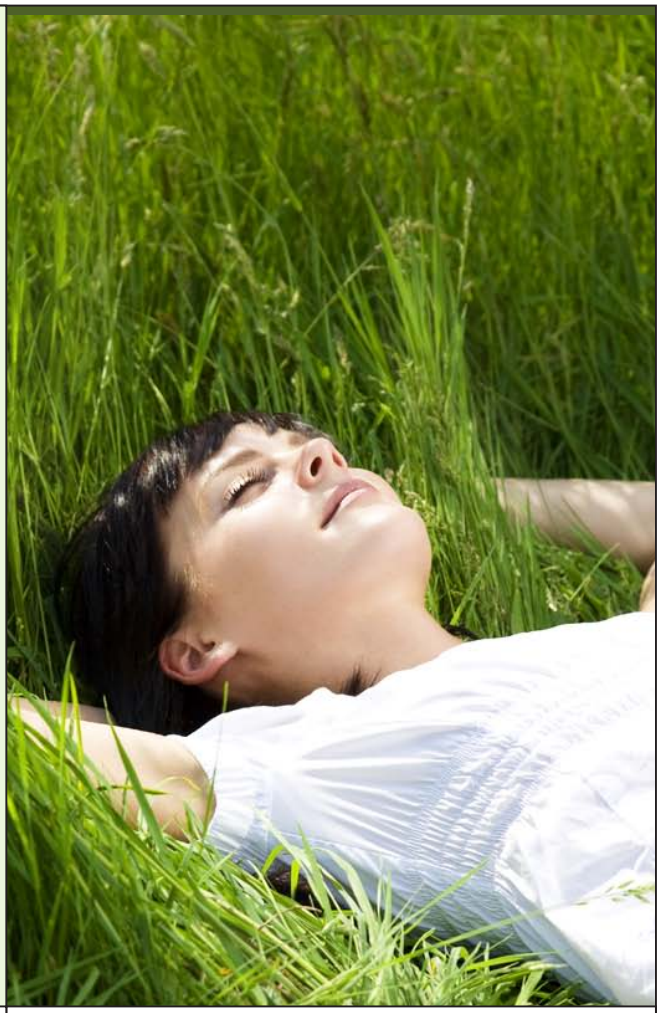

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a productive, healthy and quality life.[65-67] Despite improvements in suppression of viral replication of HIV infection, the aging HIV population will face a range of physical, cognitive, mental and social health challenges associated with HIV, comorbidities and aging.[66,67]

What we are now appreciating is the need for rehabilitation in the context of HIV[67] meaning we need to start to include prevention strategies and treatments that address an individual's physical impairments, activity limitations and social restrictions.[68,69] As naturopathic doctors, our goal is to improve the quality of life through addressing the side effects of medications, fatigue, pain, and cognitive problems. Once again, it is important to individualize treatments according to your patient's needs. Therefore, the following are guiding treatment principles.

1) *Integrative treatment* with focus on the immune system:[71]
   a. Using your modality of choice, integrative antiviral therapy and immunomodulation to overall reduce the viral load.
   b. Prevent opportunistic infections through strengthening the immune system and increasing CD4+ counts.
   c. Apply therapies that offset oxidative and free-radical damage caused by HIV infection and conventional medication.
2) Address *dietary and lifestyle* concerns as obstacles to the healing process.[71]
3) *Focus on Gut Health*: as HIV primarily targets CD4+ T cells in the intestines, it is important to focus our therapies in this area to improve the immune system, digestion and overall intestinal health, and the enteric nervous system.
4) *Prevent and support medication induced side effects.* For example: fatigue, anemia, diarrhea, nausea, vomiting, vertigo, headaches, insomnia and pain.[71]
5) Be aware of HIV drug-nutrient interactions.
6) *Screen for HCV co-infection:* approximately 25% of the HIV population will also be co-infected with HCV. Co-infection incidence rises to 50-90% for injecting drug users.[73] Please see HCV section of this paper for appropriate screening guidelines.

## Conclusion

Although aging is a natural process, it is correlated with the development of numerous chronic diseases. We can anticipate that within the next 30 years, people aged 55 and older will account for the greatest number of arthritis, hepatitis and HIV/AIDS cases. Approximately 24% of Canadian seniors have three or more chronic conditions including arthritis, cancer, depression, diabetes, heart disease, and hypertension.[72] Such multi-morbidity in our aging population creates a considerable concern for health care. As primary care practitioners, naturopathic doctors must be aware of this trend and be able to provide valuable treatments as age-demographics transform during the forthcoming 30 years.

Planning for the future requires integrating several strategies, which include: focusing on prevention in susceptible individuals, using new assessment and diagnosis technologies and managing symptoms through numerous modalities including lifestyle, diet, and counselling. This is our greatest hope to improve the lives of our elders.

## About the Authors

**Dr. Melissa Lee,** ND is a dedicated naturopathic doctor who is passionate about health. She focuses on understanding people, illness patterns and disease, allowing her and her patients to identify areas of the body that need support. She practices at the Insight Naturopathic Clinic, in Toronto. Her special interests include chronic disease/autoimmune conditions, women's health & fertility, and pain management. She also teaches acupuncture for the Neuromeridian Integrative Acupuncture Program.

**Dr. Andrea Hornyak,** BA (Psych.), ND graduated from the Canadian College of Naturopathic Medicine in 2005. She is the founder of Vital Force Naturopathic Medicine and practices out of the Norwich Medical Centre, where she is the first naturopathic doctor in Oxford County to work alongside allopathic doctors. Dr. Hornyak is the creator and author of "Spotlight on Naturopathic Medicine" in the Norwich Gazette, and has published articles in several newspapers and magazines over the years.

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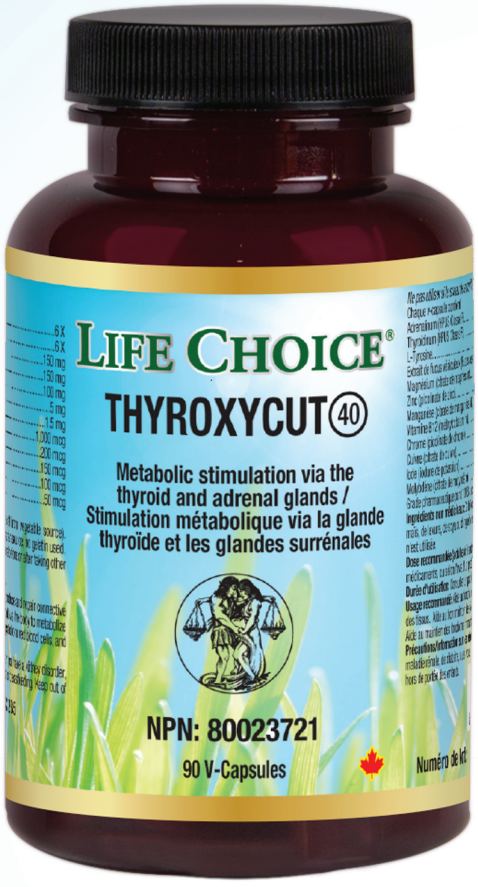


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